MACHINERY

DECEMBER 24, 1958 ONE SHILLING & THREEPENCE

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USE Eclipse HACKSAW BLADES

and
feel
the
difference!

'Eclipse' hacksaw blades and other tools are made by James Neill & Co. (Sheffield) Ltd., and are obtainable from all tool distributors.

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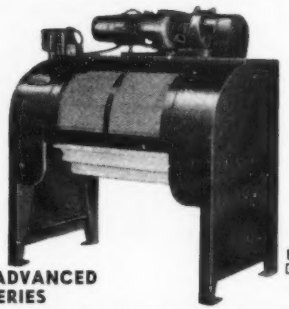
FOR DEBURRING • DESCALING • GRINDING • BURNISHING • POLISHING • FORMING RADII
MICROINCH FINISHING • RUST-INHIBITING • WORK-HARDENING

ALMCO

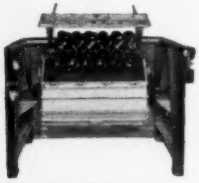
has the right barrel finishing equipment for you!



Model DB 200

ALMCO'S " ADVANCED DESIGN " SERIES

Thirteen great models in this series! These machines feature a wide range of variable speeds (infinite from 6 to 30 r.p.m.), making possible economical deburring and finishing of the greatest variety of parts. Each unit has Almco's exclusive design features and rugged construction to stand up under all types of punishing applications.

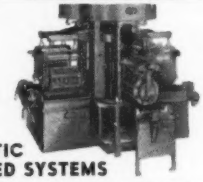


" FIXTURE " TYPE BARRELS

Pioneered by Almco for processing large and intricate parts. Custom designed fixtures hold parts securely, prevent part-on-part impingement and allow abrasive action to reach all surfaces, cavities, slots, etc. Barrels have automatic forward and reverse controls.

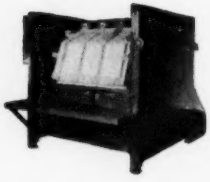
MULTI-COMPARTMENT BARRELS

Do you have these deburring and finishing problems—wide variety of parts or small quantity runs where fixtures would be too costly? Lack of floor space for several machines? An Almco custom-designed multi-compartment barrel may give you a cost-saving answer. Automatic forward and reverse. Any combination of compartments and doors.



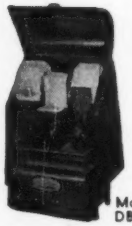
SUB-O-MATIC AUTOMATED SYSTEMS

Almco's exclusive submerged unit is an automatic, " assembly line " system for micro-precision deburring and finishing of small parts in quantity. Saves labour, speeds up processing and flow of high production parts. One man can operate this equipment and handle as many as 192 barrel loads per 16 hr. day. Slashes compound expense to minimum. These submerged systems can also be obtained in non-automated, straight line systems.



CUSTOM-DESIGNED BARRELS

Almco designs and manufactures special barrels of all types for problems where standard equipment cannot be effectively used. These range from the smallest type to the largest fixture barrel such as the 60" diameter x 60" length barrel shown above. Special large diameter barrels with double flat or triple flat doors are also available to accommodate extra large parts and to allow abrasive media to flow freely over the outer periphery of the part. Your special problems may be solved with one of Almco's custom-designed barrels.



Model DB 01A

SMALLER MACHINES

Twin barrel machines manufactured by Almco are the standard of the industry for processing small lots of parts and for companies with large lots of small parts. Also ideal for sample processing, barrel finishing research and development work. These units are Almco engineered to the highest specification standards and include operational and safety features found on larger Almco machines.

YOUR SAMPLE PARTS PROCESSED without obligation in modern Almco test labs. Simply send parts direct to Hitchin, Herts. Enclose specifications desired. Complete free report includes recommendation.

Almco deburring and finishing machines are ruggedly constructed to perform on a round-the-clock basis. They incorporate the best engineering design required in the industry—your assurance of versatility and economical processing of work parts. Optional equipment includes material handling devices and systems, automatic forward and reverse, double or triple flat doors, single and dual timer controls for automatic delay starting and stopping, perforated drain doors for flushing and rinsing unloading devices, etc. Also a full and complete line of Almco Supersheen barrel finishing compounds and media of all types made especially for use with Almco precision barrel finishing equipment.

ALMCO Supersheen

BURY MEAD WORKS · HITCHIN · HERTS

Telephone: Hitchin 3669

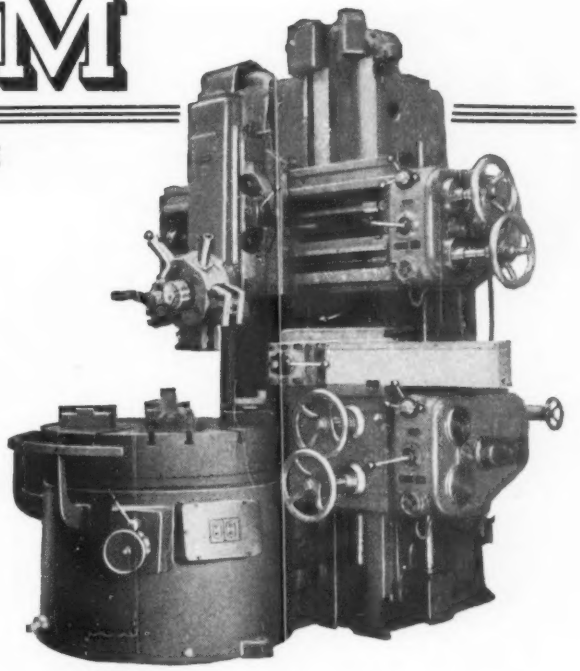
HOLLAND (Rotterdam) N.V. Technische Handelsonderneming " Carborundum-Aloxite " : **BELGIUM & LUXEMBURG (Bruxelles)** Tecnimetal Societe Anonyme : **SWEDEN (Stockholm)** Trumlingsaktiebolaget : **SWITZERLAND (St. Gallen)** L. Kellenberger & Co. : **SOUTH AFRICA (Johannesburg)** Barry Colne & Co. (Pty.) Ltd. : **AUSTRALIA & NEW ZEALAND (Melbourne)** Hardie Trading Ltd.

DEFUM

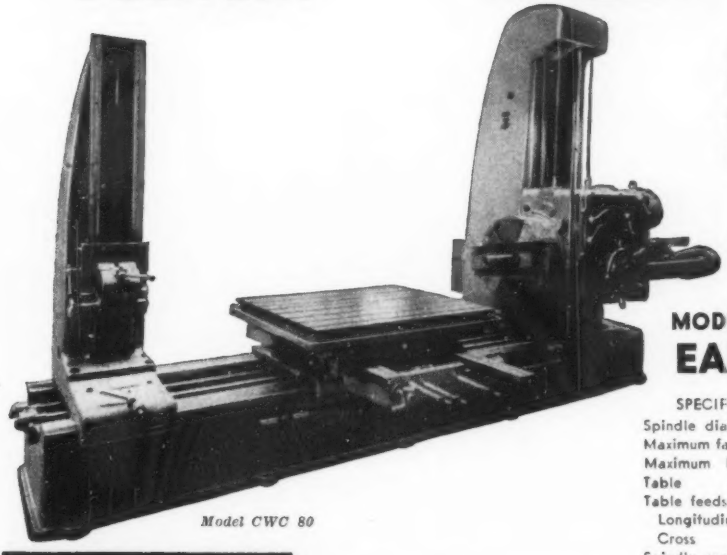
VERTICAL BORING MACHINE KNA 110

- Pre-selection of 16 table speeds
- Cross and side heads have independent rapid vertical and horizontal traverses
- Thread cutting and taper turning attachments

Maximum turning diameter with side head ..... 3' 7"
Maximum turning height ..... 3' 1½"
Table speeds (16) ..... 4½ - 140 r.p.m.
Feeds to tool heads (12) 0.008"-0.394" per rev.



MODEL KNA 110
IMMEDIATE DELIVERY



Model CWC 80

HORIZONTAL BORING & MILLING MACHINES CWC 80 & HWC 110

- Independent drive to spindle and facing head
- Hand and power drive to rotary table
- Heavy duty facing head

MODELS CWC 80 & HWC 110
EARLY DELIVERY

SPECIFICATION	CWC 80	HWC 110
Spindle diameter	3"	4 1/16"
Maximum facing diameter	36"	48"
Maximum boring depth	28"	33"
Table	35" x 44"	47" x 55"
Table feeds:		
Longitudinal	39"	61"
Cross	32"	47"
Spindle speeds	(15) 15-515	(18) 8½-562

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ELGAR MACHINE TOOL COMPANY LIMITED

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Burr-Free components and extreme accuracies through critical control of die-clearance and draft in segmental dies.

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ALL THREADS
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COMPANY LTD
The range, in both Brass and Steel, is from 0.BA to 5 BA and 1/16 to 1/8 inch diameter and between 1/2" and 4" long. Recommended for use within this range, with rolled threads, where studding in these lengths in cut threads would be too expensive. Please send for stock lists.
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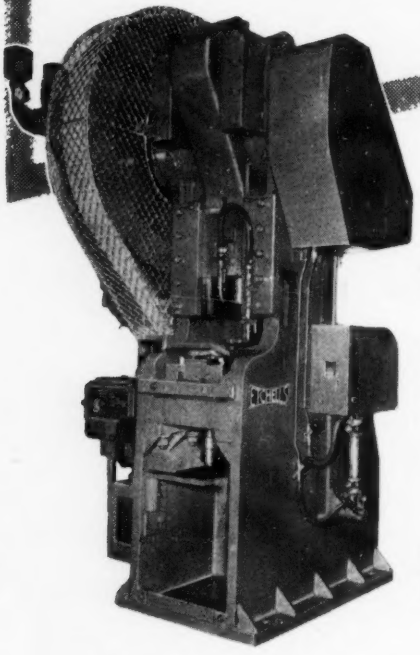
Two minds with but a single thought —

HIGH PRODUCTION

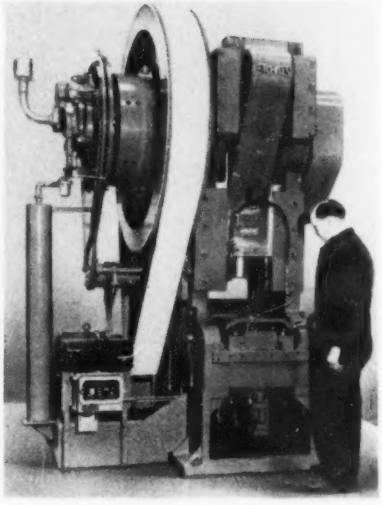
ETCHELLS

FORGING MACHINES WITH

The STEPHENS Miraclo NYLON BELT
WITH CHROME LEATHER DRIVING FACE



No. 2 Etchells Vertical Forging Machine—write for details.



Brochure 103 tells you HOW TO DESIGN A MIRACLO DRIVE.

Etchells and Miraclo are both renowned for the high production they give. The Etchells No. 0 forging machine produces 20 forgings per minute with hand-fed blanks — no wonder it has aroused much interest in the nut and bolt trade.

Miraclo, the bonded nylon and chrome leather belt, is fitted to all Etchells machines because of its qualities of no slip, stretch or loss of power and because Miraclo has long life and needs no maintenance. Remember, for faster forgings it's Etchells and for the best drive on all machines fit Miraclo.

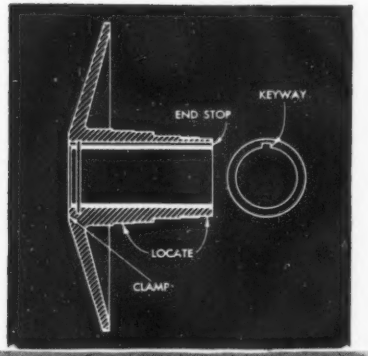
DAVID ETCHELLS & SON LTD.
BULL PIECE WORKS, DARLASTON
S. STAFFS

STEPHENS BELTING CO. LTD.
SNOW HILL : BIRMINGHAM 4
Northern Office and Works:
IRA STEPHENS LTD., Ashton-under-Lyne, Lancs.

S78

HEALD Versatility . . .

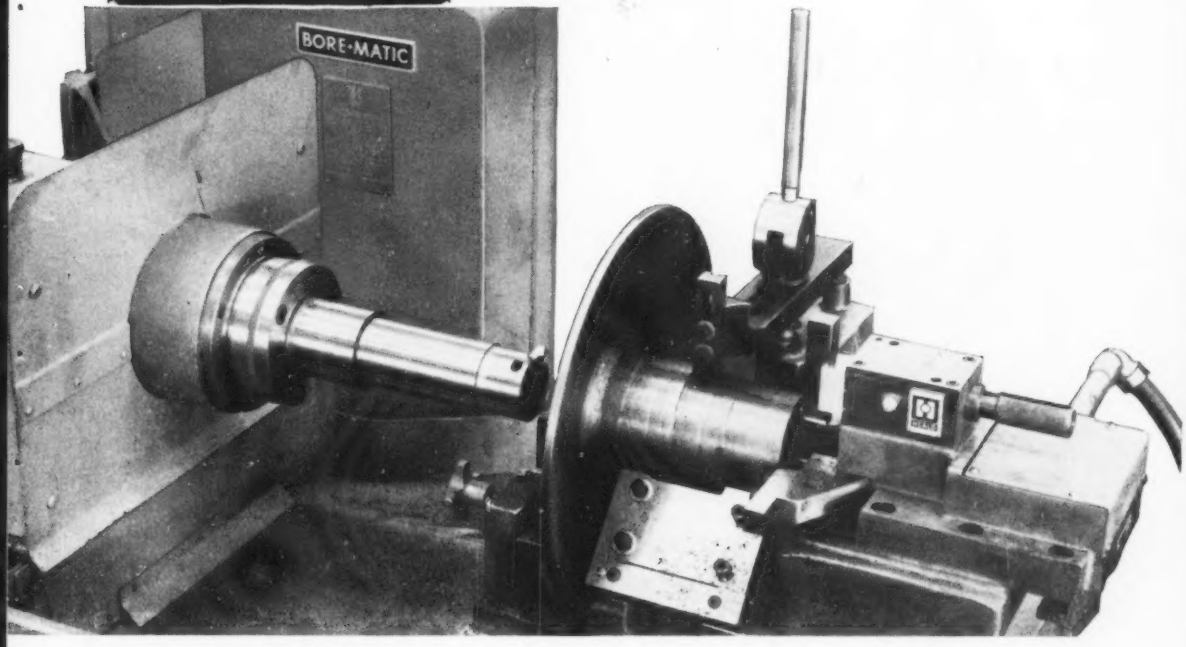
. . . 41 different components machined on a Model 221 Borematic. Bores ranging from ·668″ dia. x $2\frac{3}{8}$″ up to 3·2510″ dia. x $9\frac{3}{8}$″



Interchangeable tooling and fixtures enable a single Heald Borematic to be used to advantage even on short production runs requiring frequent change-overs.

The illustration shows the boring of one of the 41 parts which are dealt with on this one Model 221 Heald Borematic. Compared with the previous method output has been increased from 4 to 13 parts per hour.

Models 221, 222, 321, 322, 421 and 422 are now built in this country. Our specialists are available to advise on their application.



Sole Agents and Tooling Engineers: AD.328

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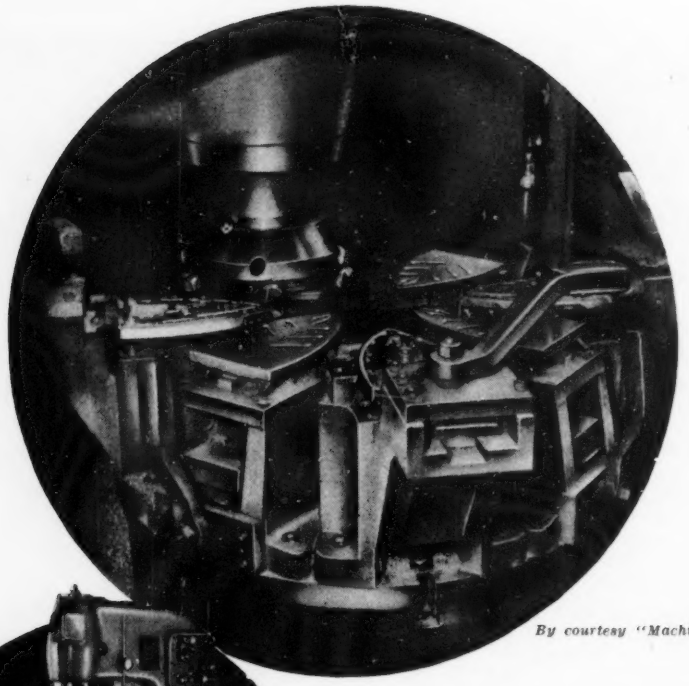
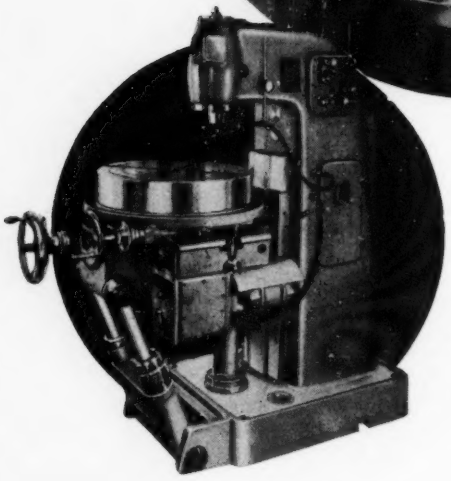


By courtesy "Machinery"



THE SCHUBERT

CONTINUOUS MILLING MACHINES

in operation at Hoover Ltd. on iron sole plates

The power operated circular table eliminates stoppages for loading and unloading

PRINCIPAL DIMENSIONS

Milling table diameter	23.6 in.	Cross Traverse of the table (manual)	14.6 in.
Vertical Movement of the table (manual)	8.8 in.	Range of milling speeds	51-1,200
		Number of table feeds	9

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BY SACK & KIESSELBACH

SEVERAL SIZES from 100—3,000 TONS CAPACITY
MASSIVE CAST STEEL BODY
PATENT SWIVELLING CLEAR-VIEW GUARD
CAN BE USED with DEPTH or PRESSURE LIMITING DEVICE
BUILT FOR THE JOB

Note depth measuring device, automatically stopping machine when required depth has been reached.

SACK & KIESSELBACH have for many years been building Cold Hobbing Presses. These machines are therefore not adaptations but are designed and built for this work only. Their sound, robust basic design, high quality workmanship plus several special features found only on these machines greatly facilitates the production of sound moulds. Further details on request.

ROCKWELL
MACHINE TOOL CO. LTD.

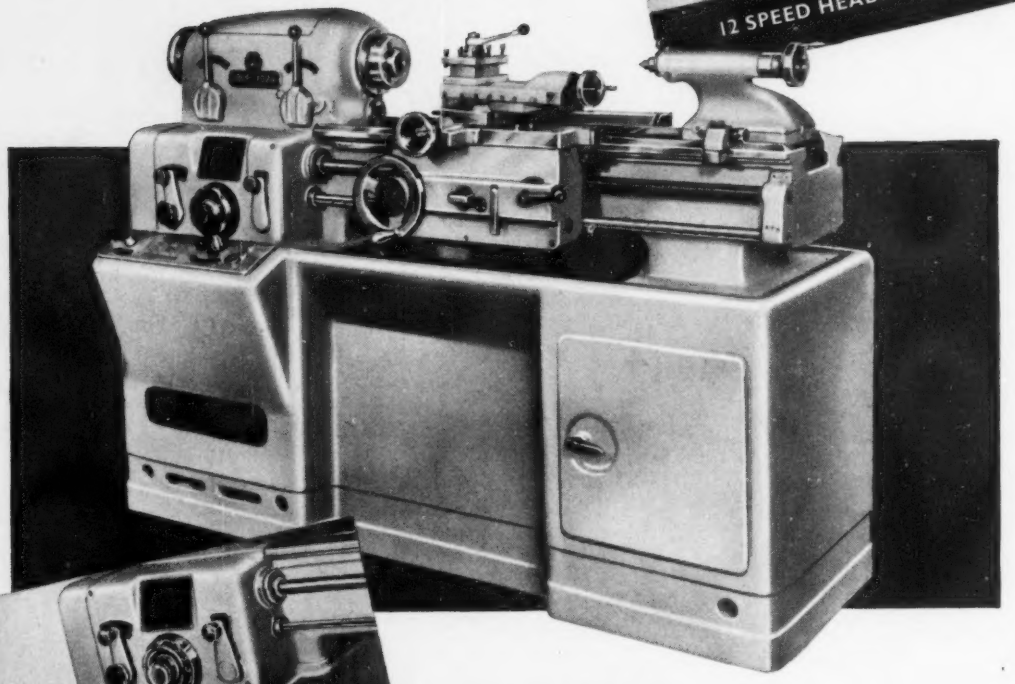
WELSH HARP, EDGWARE ROAD, LONDON, N.W.2. TEL: GLADSTONE 0033

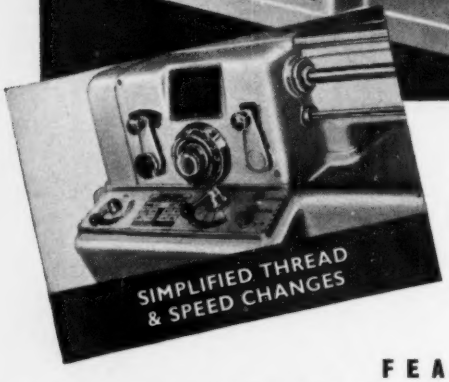
ALSO AT · BIRMINGHAM-TELEPHONE SPRINGFIELD 1134/5 · STOCKPORT-TELEPHONE STOCKPORT 5241 · GLASGOW-TELEPHONE MERRYLEE 2822

SK1

A★

New! Smart & Brown Precision Toolroom Lathe





MODEL 1024

The latest addition to the range of Smart & Brown toolroom lathes has been designed to ensure the h'ghest degree of accurate operation while reducing operator's unproductive time to a minimum.

FEATURES

- 12 Spindle Speeds 30-2500 RPM
- 1″ Collet Capacity
- Easy Selection of 40 Threads and Feeds 4-112 TPI
- Cam Lock Spindle Nose 4″ D.I.
- Flame Hardened Bed
- Easy to Read Thread Dial Indicator
- Fully Protected, Easily Accessible Electrical Equipment
- Swing Over Bed 11″
- Distance Between Centres 24″

ROCKWELL
MACHINE TOOL CO. LTD

For further particulars write or telephone TODAY

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YORK SHIPLEY USE HARPER CASTINGS

—and Harper service too!

Not only do Harpers make the cylinder castings for York Shipley refrigeration plant, but they deliver them to the customer as a finished machined component.

The requirements of commercial and industrial refrigeration practice require the castings to be free from porosity or defect. The outer surface and ends are machined in *Harper's own machine shop* to a tolerance of 0.0005 in., and the bore is also honed to a tolerance of 0.0005 in., the degree of finish being 7 micro-inches.

Harper Quality covers Grey Iron, Spheroidal Graphite Iron (Mond Nickel Licence) and Meehanite castings.

Also metal pressings, machining, enamelling and other finishes and sub-assembly work.

Also makers of the famous Beatrice Oil Heaters and Harper Housewares.

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JOHN HARPER & CO. LTD. **JOHN HARPER** (MEEHANITE) **LTD.**
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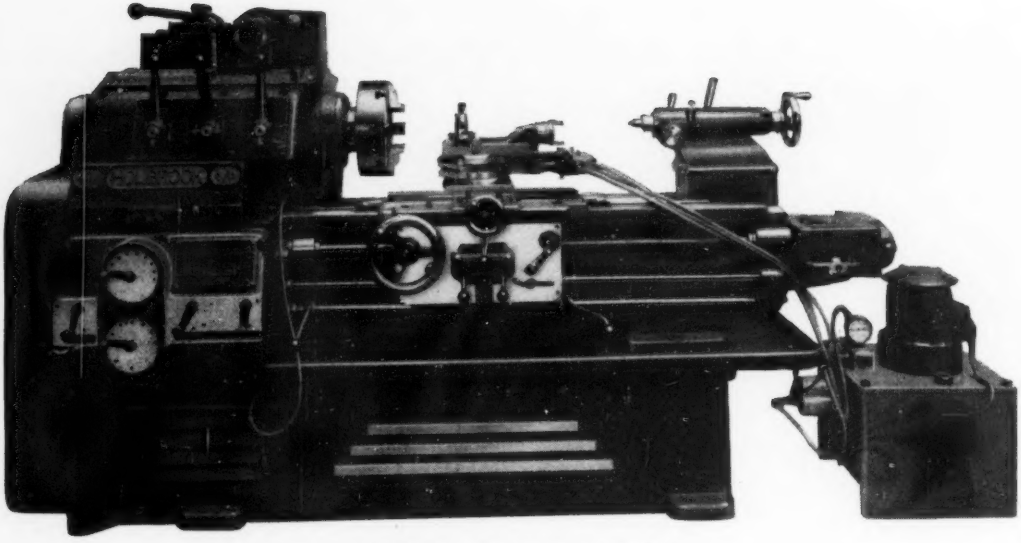
Holbrook

STRATFORD — LONDON — ENGLAND



MODEL "M" No. 15/20

MOULD-MAKERS' LATHE

THE LATEST DESIGN OF MOULD-MAKERS' LATHE HAS INCREASED SWING OVER BEDWAYS (21") AND AN ADDITIONAL UNIVERSAL HYDRAULIC SLIDE FOR SQUARE SHOULDER WORK AND PROFILING IN ANY DIRECTION. NON CIRCULAR SHAPES ARE PRODUCED FROM A REVOLVING PATTERN IN ADDITION TO NORMAL PROFILING BY USING TWIN HYDRAULIC UNITS. 36 SPINDLE SPEEDS, FORWARD AND REVERSE RANGING FROM 0·15 TO 1,000 R.P.M., BUILT-IN PITCH VARIATOR FOR MOULD THREADS.

The Finest Lathe in its Class

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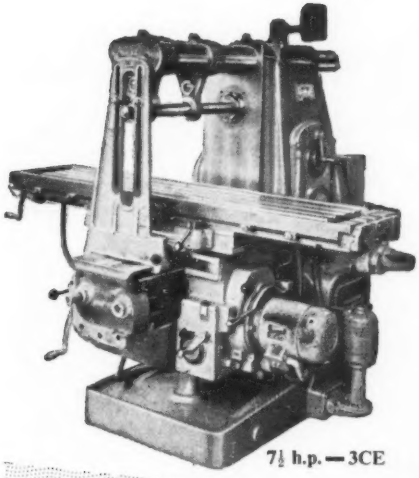


7½ h.p.—3CE

The ever increasing range of C.V.A. Kearney and Trecker Milling Machines, built by C.V.A. Jigs, Moulds and Tools Limited under licence from the Kearney and Trecker Corporation, Milwaukee now includes:

3 h.p. 2CE with 16 speeds

25 to 1,300 r.p.m. (Horizontal) 30 to 1,575 r.p.m. (Vertical)

and **16 feeds** — ½ inch to 25 inch

7½ h.p. 3CE with 16 speeds

25 to 1,300 r.p.m. and **16 feeds** — ½ inch to 25 inch

Both models are fitted with independent feed drive motors and are available as Plain, Universal and Vertical styles. Both Plain and Vertical Machines can also be fitted with automatic cycle table control.

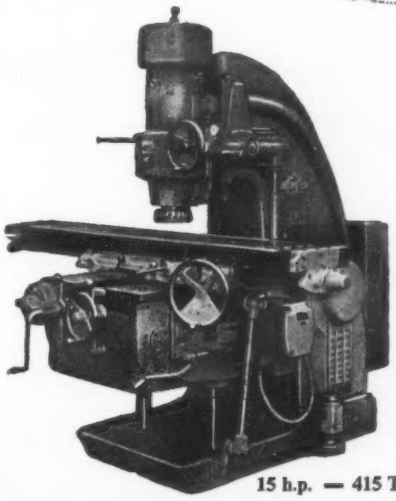
MILLING KEARNEY & TRECKER MILWAUKEE MACHINES

Complete series of Model 3 and 4 T.F. Machines in Plain, Universal and Vertical styles from 10 h.p. to 30 h.p. Monolever and automatic cycle table control is standard on all styles.

The T.F. range features twin vertical screws giving equal weight distribution and increasing stability under the heaviest cutting loads.

Also available is the 2D Rotary Head Machine with its unique action enabling the most complex jobs to be completed in a single set-up.

Write for details of the CE T.F. and 2D Rotary Head Machines.



15 h.p. — 415 T.F

E.H. JONES (MACHINE TOOLS) LTD

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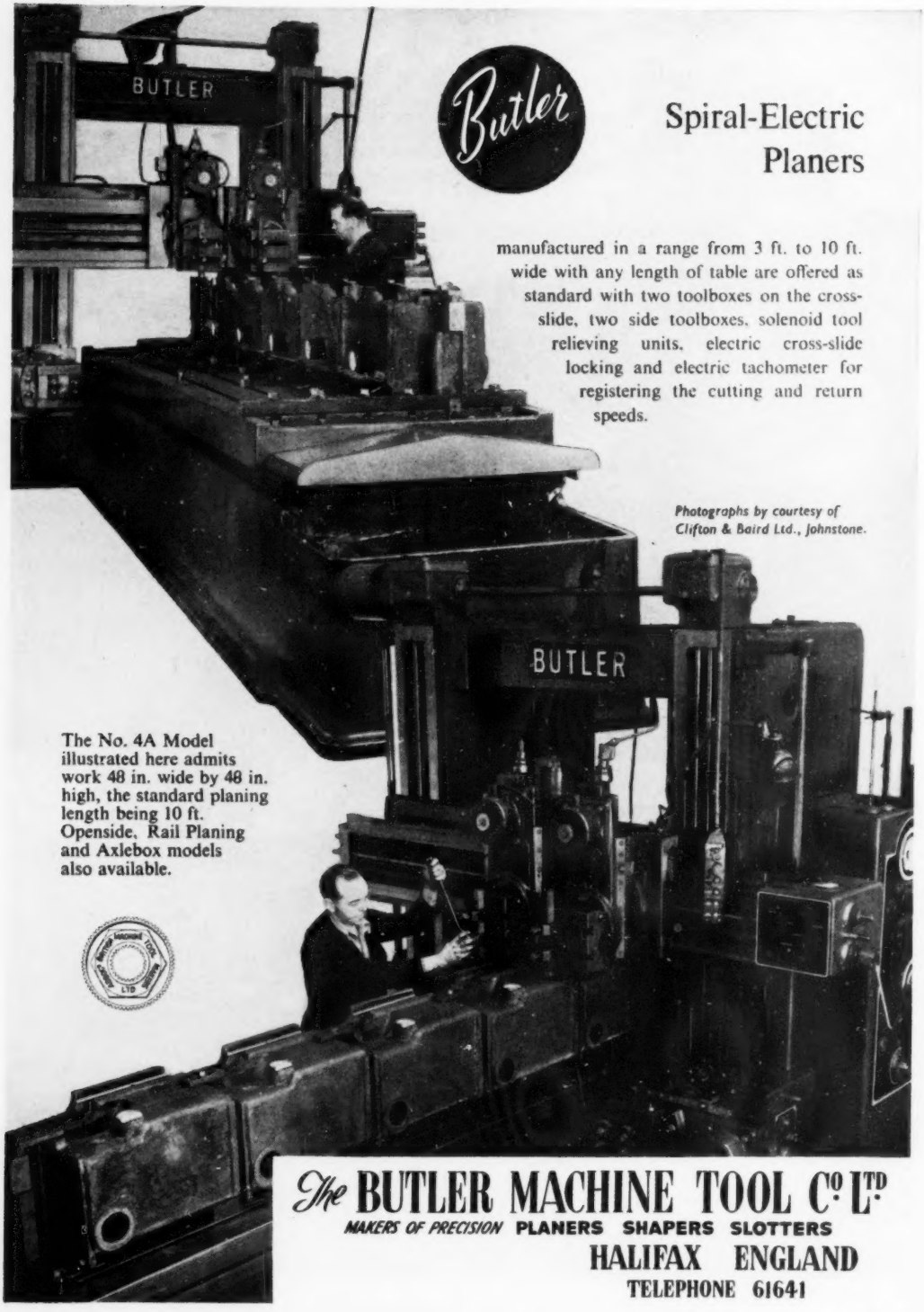

Butler

Spiral-Electric Planers

manufactured in a range from 3 ft. to 10 ft. wide with any length of table are offered as standard with two toolboxes on the cross-slide, two side toolboxes, solenoid tool relieving units, electric cross-slide locking and electric tachometer for registering the cutting and return speeds.

Photographs by courtesy of Clifton & Baird Ltd., Johnstone.

The No. 4A Model illustrated here admits work 48 in. wide by 48 in. high, the standard planing length being 10 ft. Openside, Rail Planing and Axlebox models also available.

The BUTLER MACHINE TOOL Co. LTD

MAKERS OF PRECISION **PLANERS SHAPERS SLOTTERS**

HALIFAX ENGLAND

TELEPHONE 61641

B323

For Maximum Production on Capstan and Turret Lathes

INSTALL

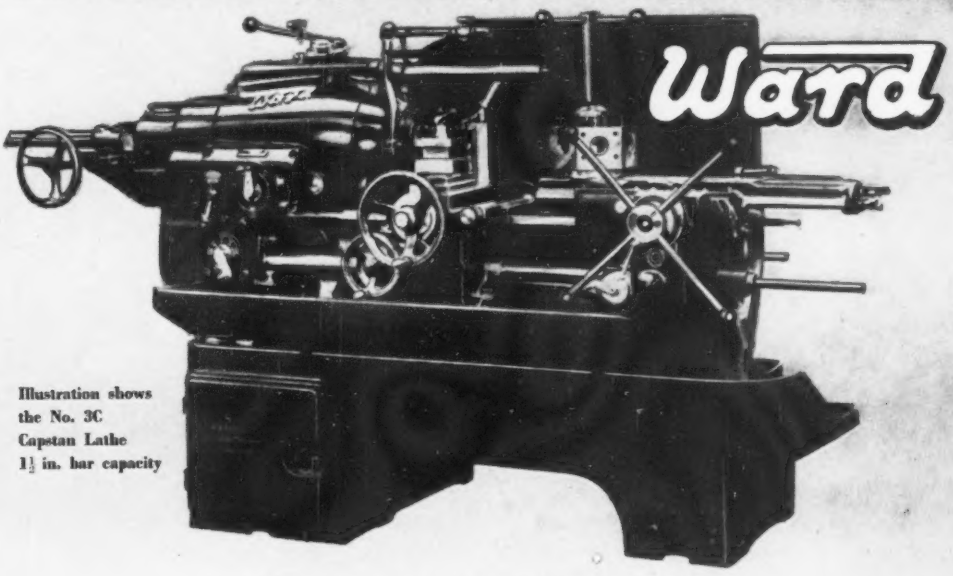

Illustration shows the No. 3C Capstan Lathe 1¼ in. bar capacity

Many new features include
12 spindle speeds – both forward and reverse
Higher centres giving increased swing
Bed protected by stainless steel covers
Inbuilt electrical equipment
Large capacity swarf pan

Full details of our complete range of Capstan and Turret Lathes on request.

H·W·WARD & CO LTD
SELLY OAK
BIRMINGHAM 29
TELEPHONE SELLY OAK 1131

W670

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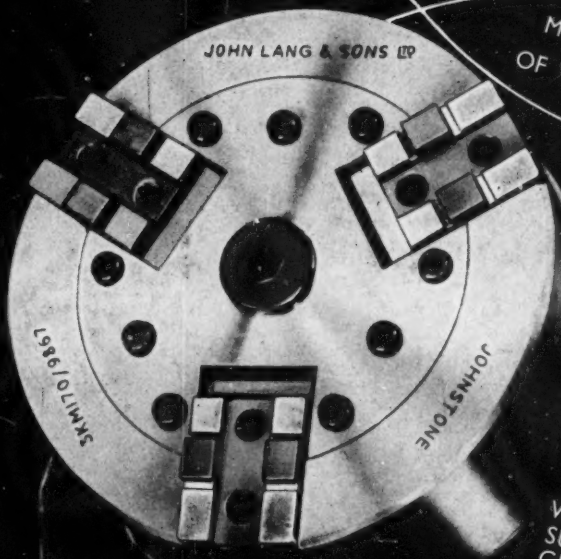
Power Chucks



MINIMUM NUMBER OF WORKING PARTS.

5" DIA. TO 20" DIA.

ALL WORKING SURFACES GROUND.

ALL PARTS INTERCHANGEABLE.

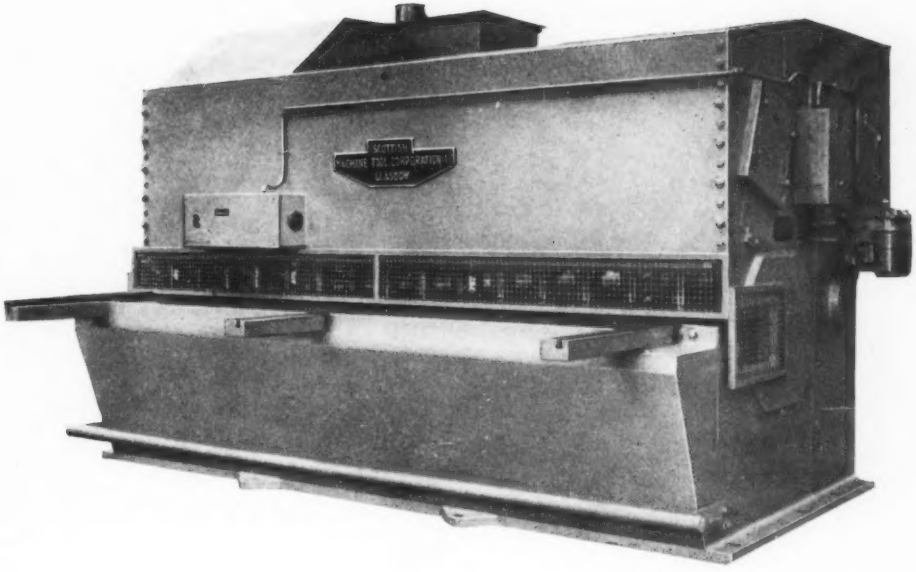
In a sphere of its own

LONDON OFFICE
ASSOCIATED BRITISH MACHINE TOOL MAKERS LIMITED
17 GROSVENOR GARDENS SW1

JOHN LANG & SONS LTD.
JOHNSTONE RENFREWSHIRE SCOTLAND
Telephone Johnstone 400 Telegrams "Lang Johnstone"

L216M

SCOTTISH machine tool corporation limited



hydraulic guillotine shears

Our latest type of guillotine with all the advantages of hydraulic drive and clamping. Massive construction and a very efficient arrangement of the rams, giving improved force distribution, ensure long life and maintained accuracy. Available up to 12 ft. wide for a variety of plate thicknesses. Full details are contained in a leaflet which we shall be glad to send on request.

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58 Victoria Street, LONDON, S.W.1. *Victoria* 2106
2 Sir Harry's Road, Edgbaston, BIRMINGHAM, 5. *Calthorpe* 2541
The Building Centre, Brunswick Terrace, LEEDS, 2. *Leeds* 25250

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GEAR HOBBERS & GEAR SHAPERS

Backed by over 35 years' experience

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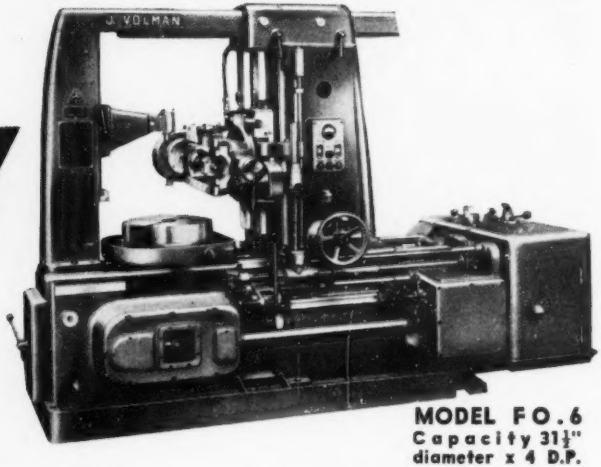
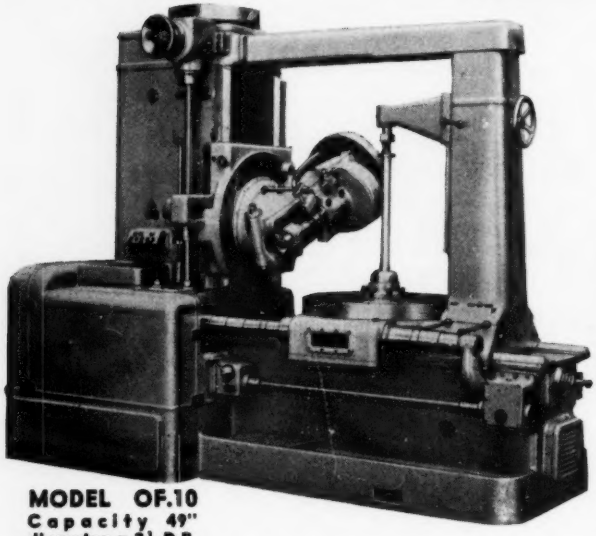


MODEL F O . 6
Capacity 31½" diameter x 4 D.P.



MODEL OF.10
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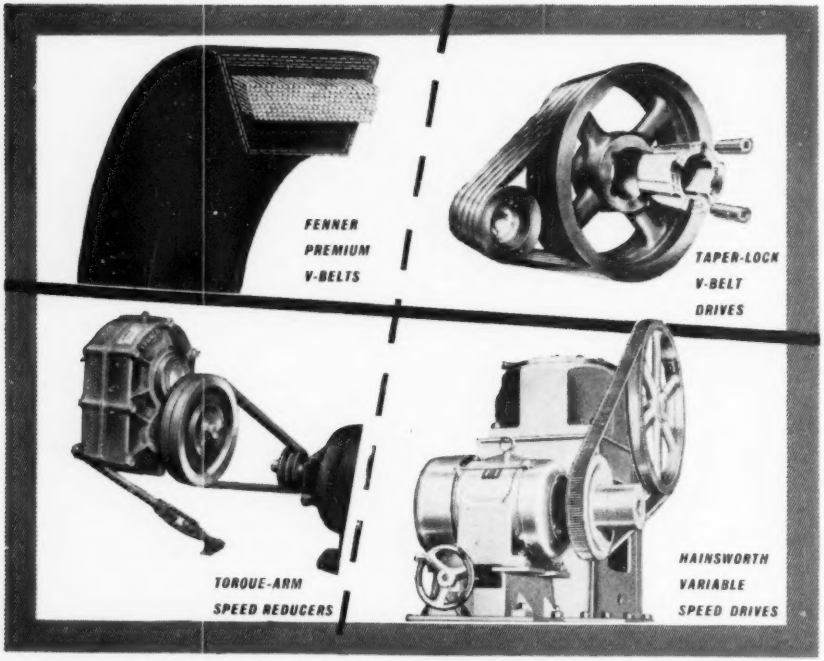

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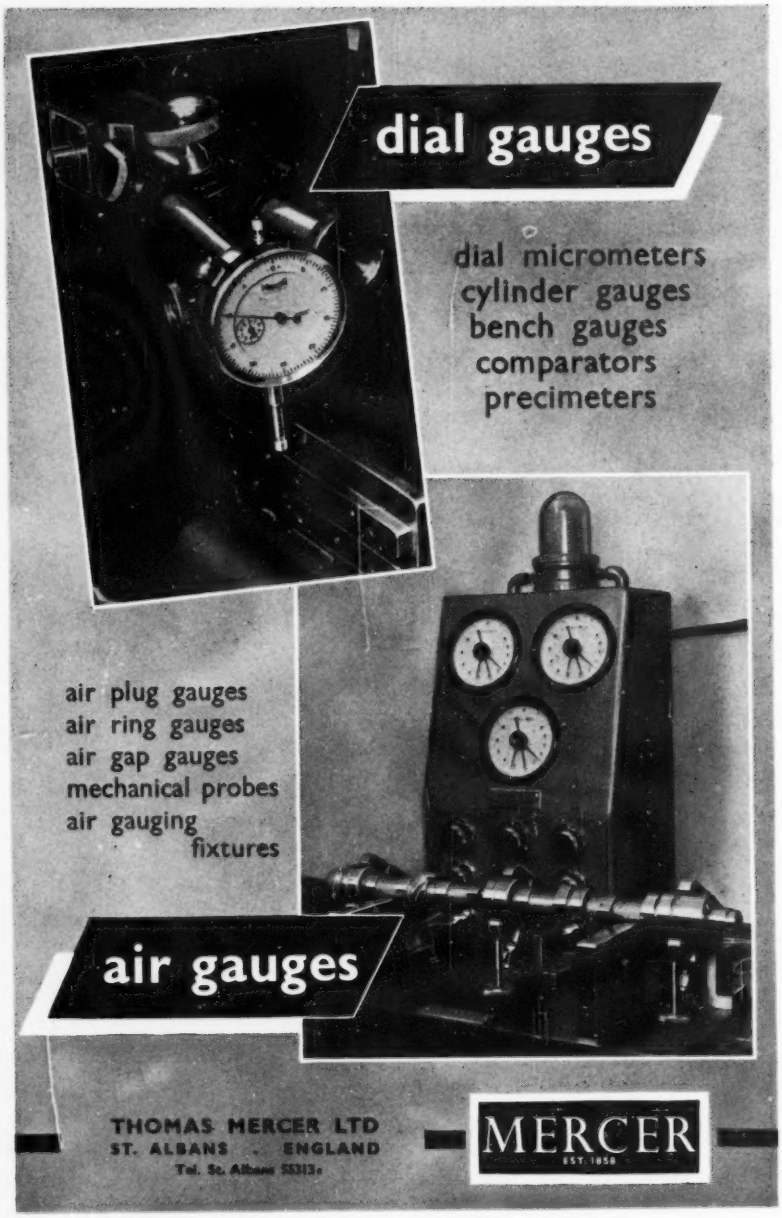

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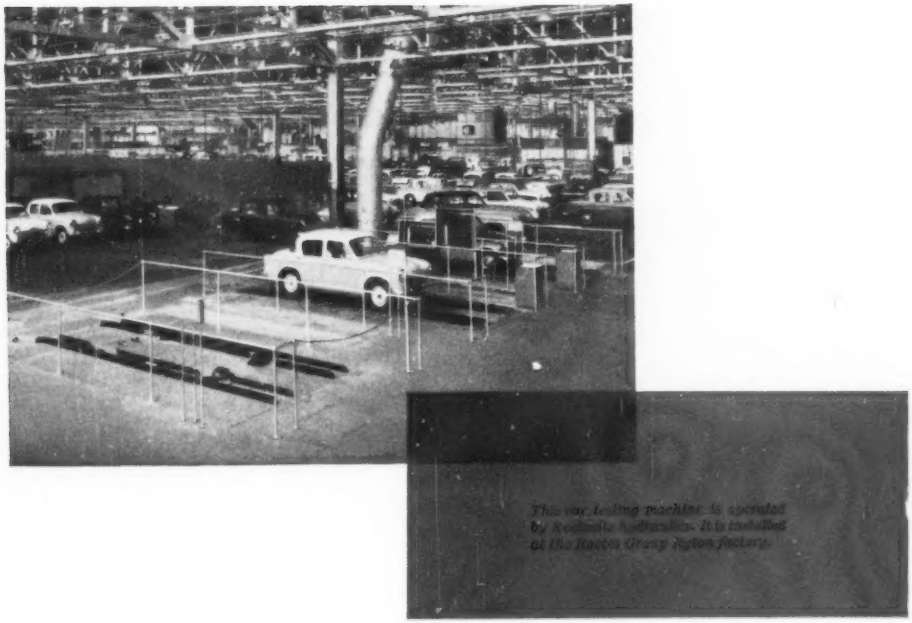

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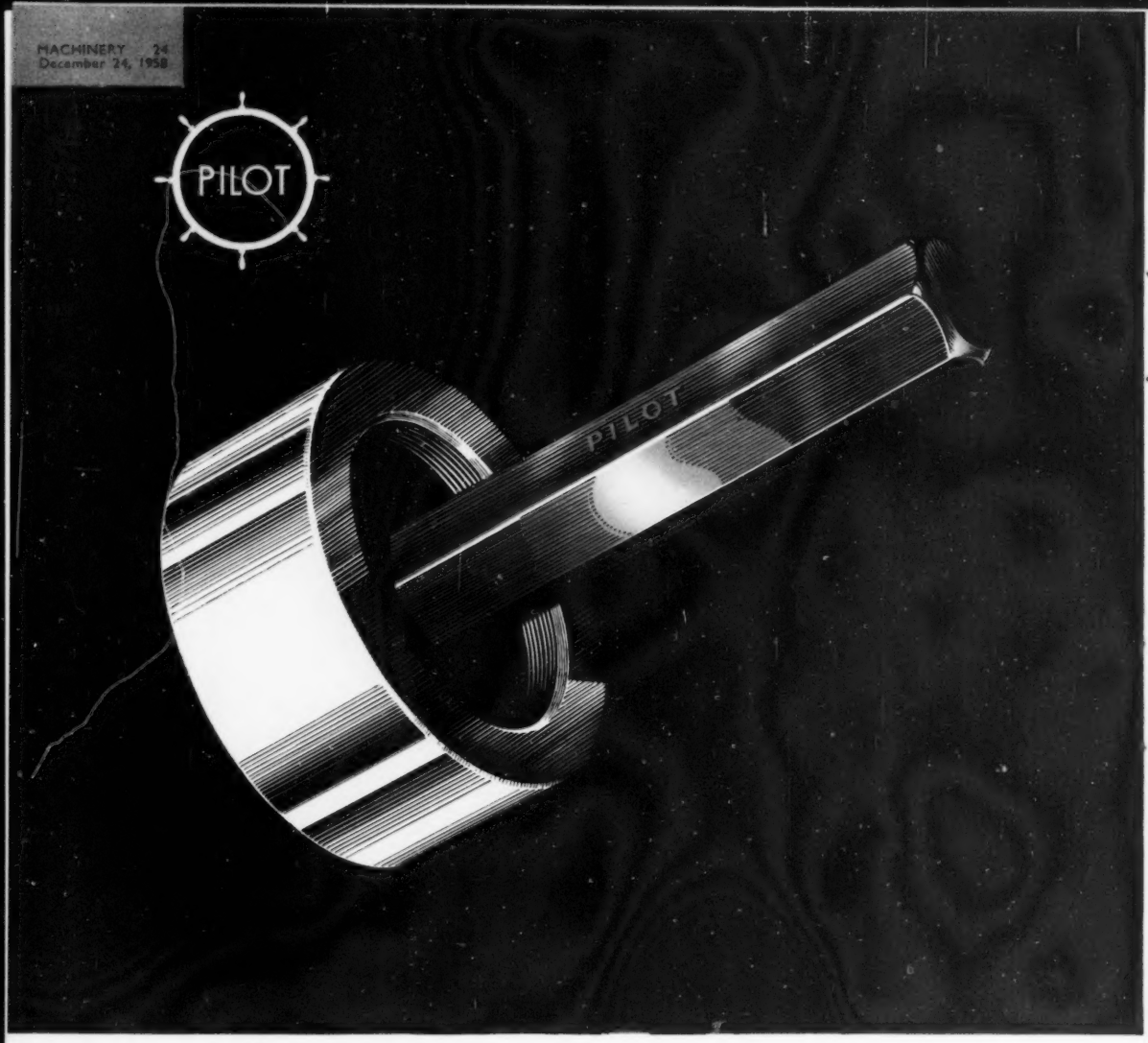

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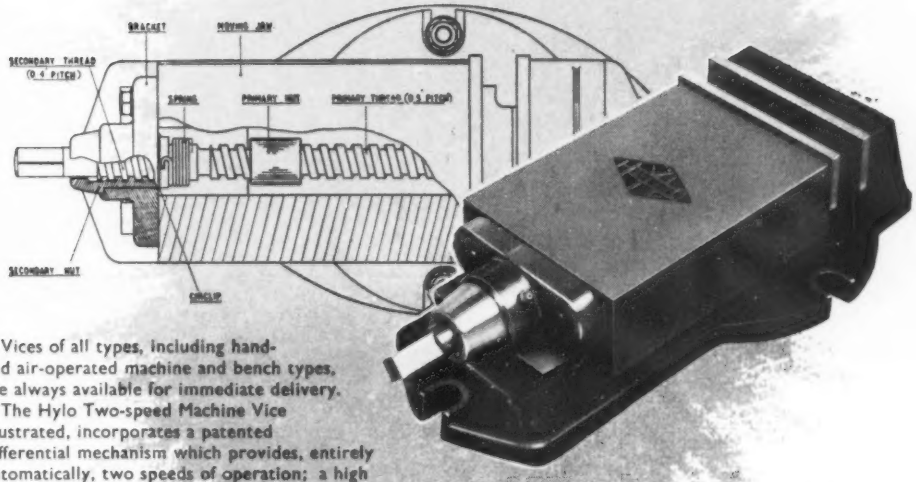

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The Hylo Two-speed Machine Vice illustrated, incorporates a patented differential mechanism which provides, entirely automatically, two speeds of operation; a high speed for rapid advance and return of the moving jaw and a low speed for providing the essential grip on the workpiece. It is made in four sizes—3in., 4½in., 6in. and 8in. with plain or swivel base.

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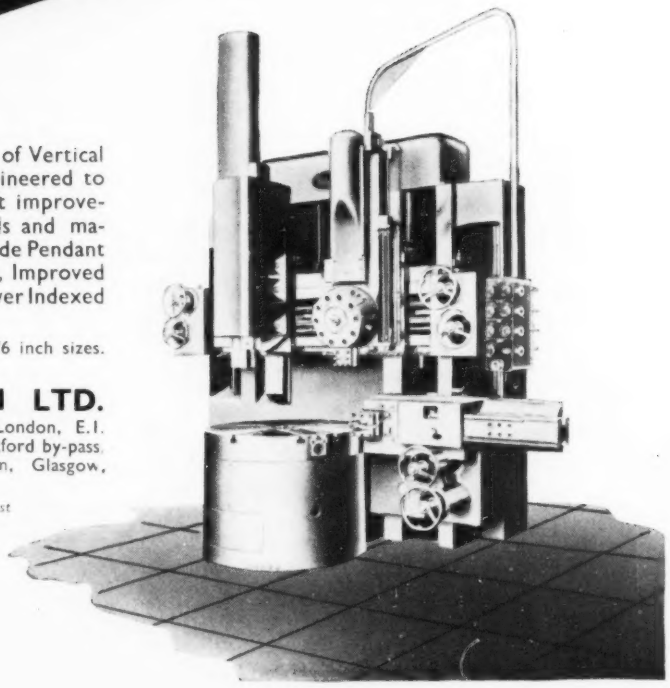

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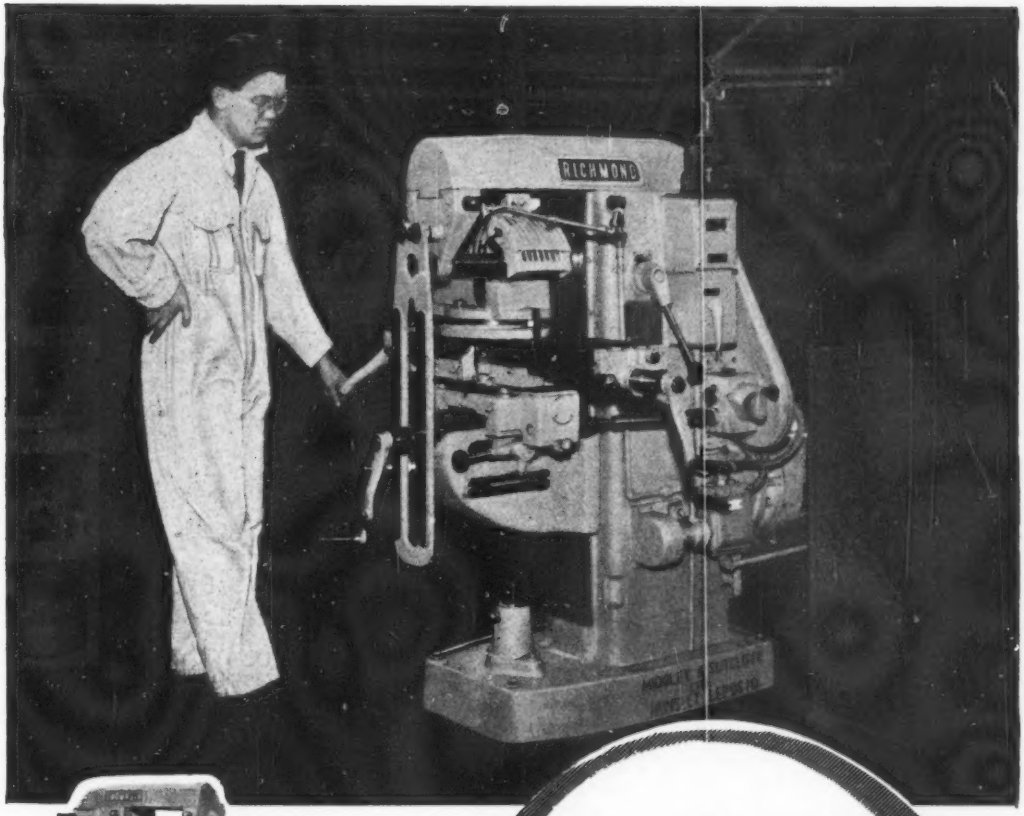

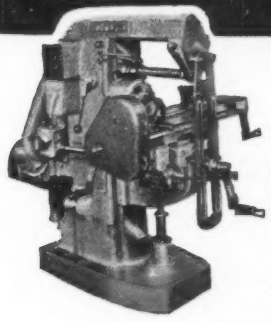

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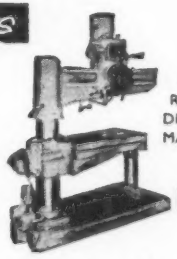

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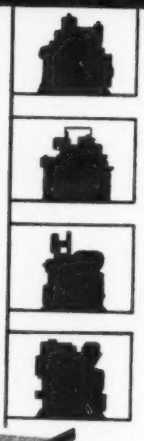

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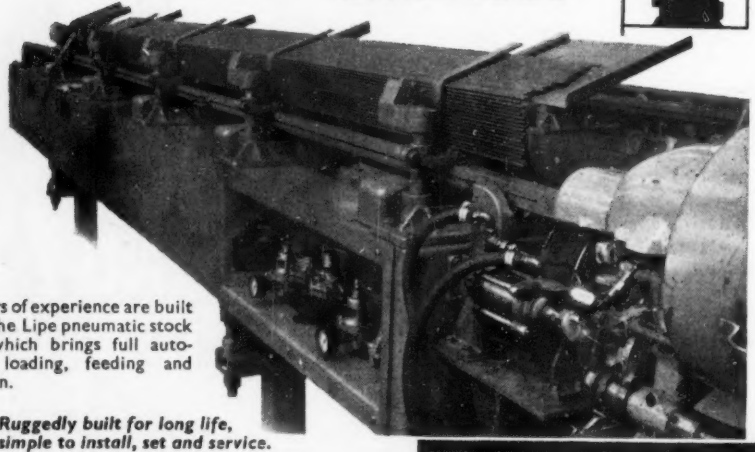

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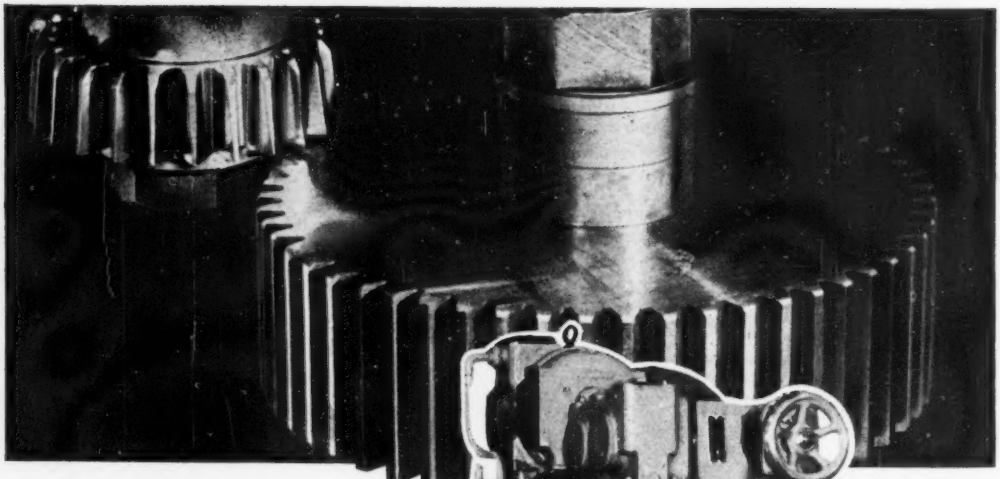

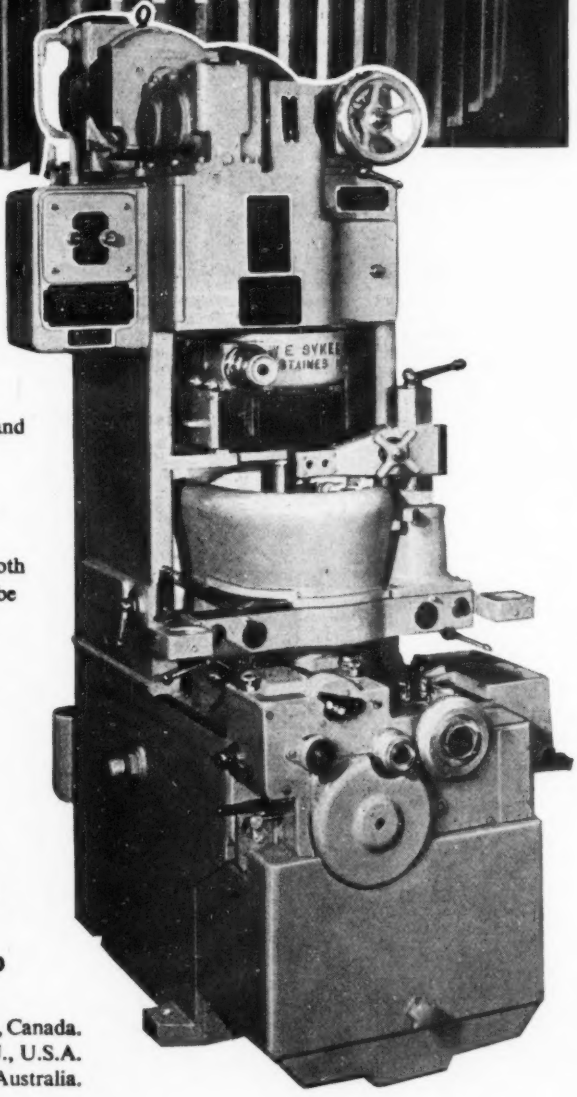

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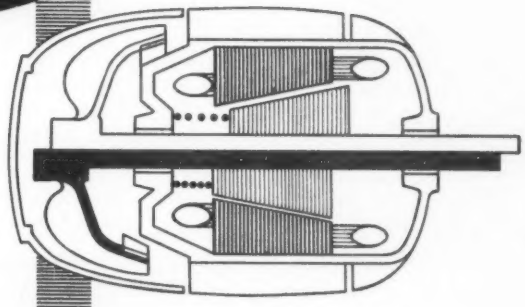

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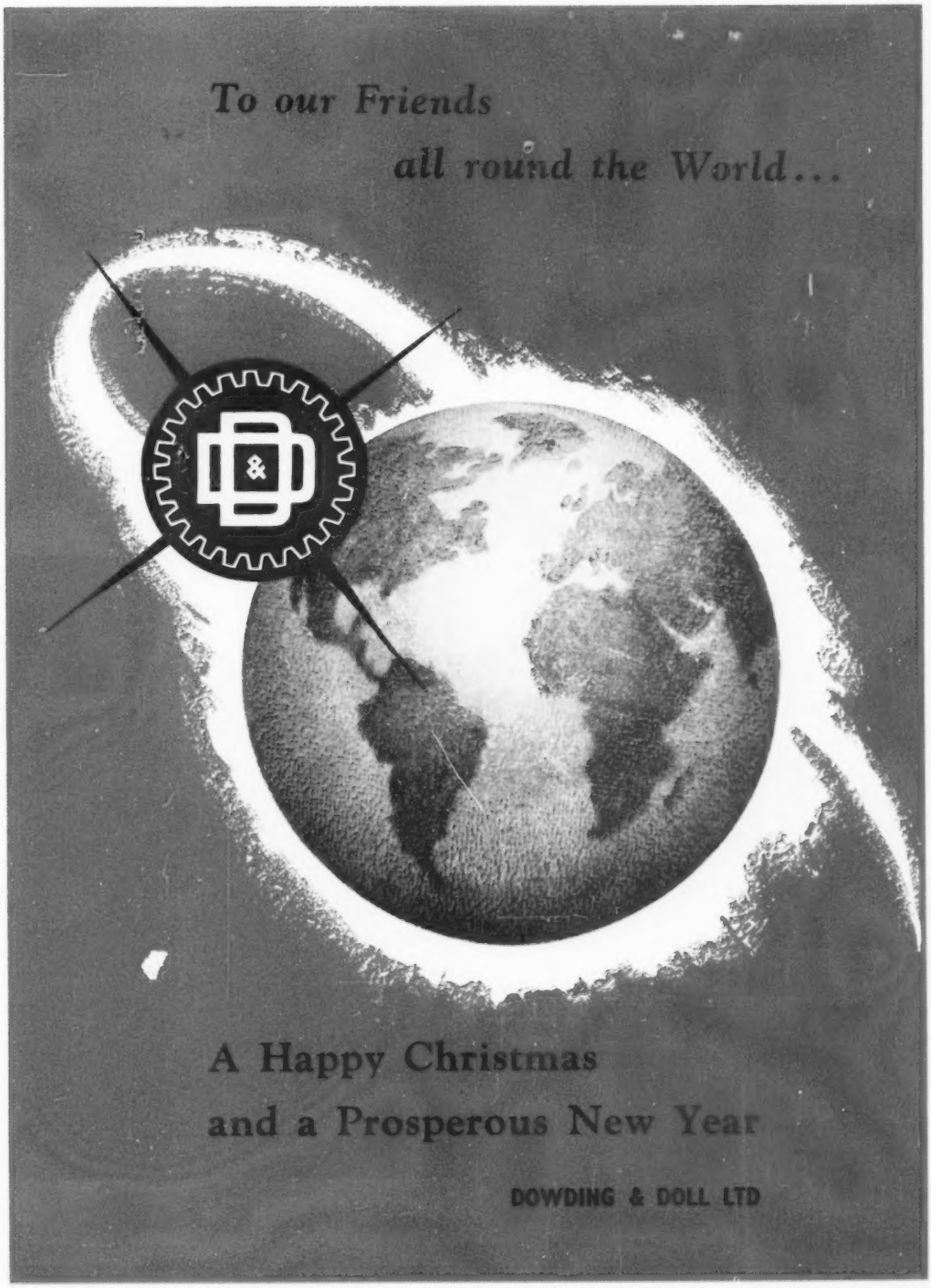
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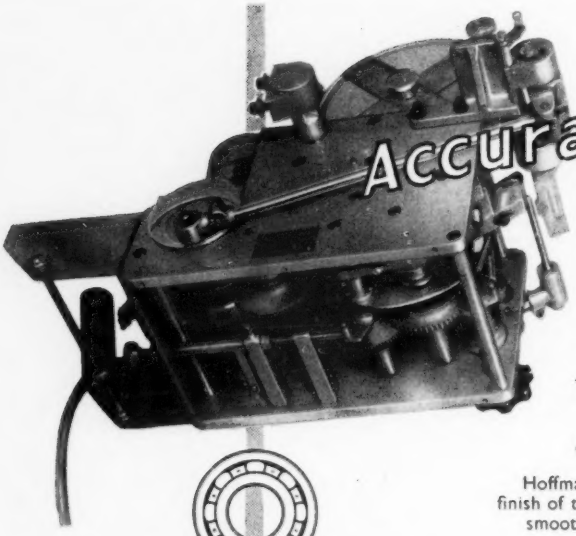

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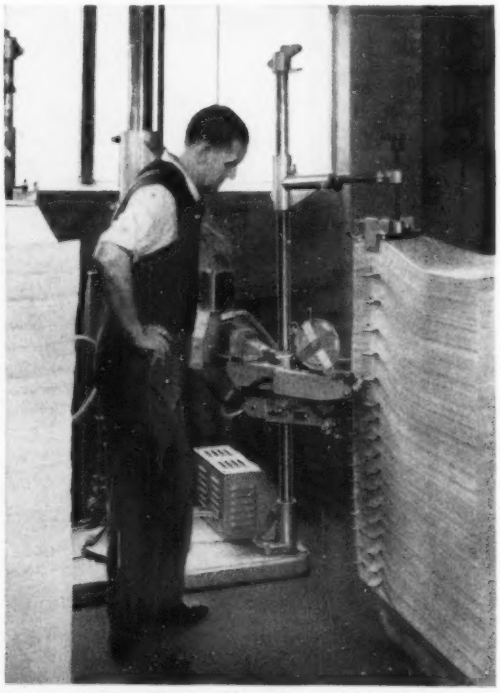

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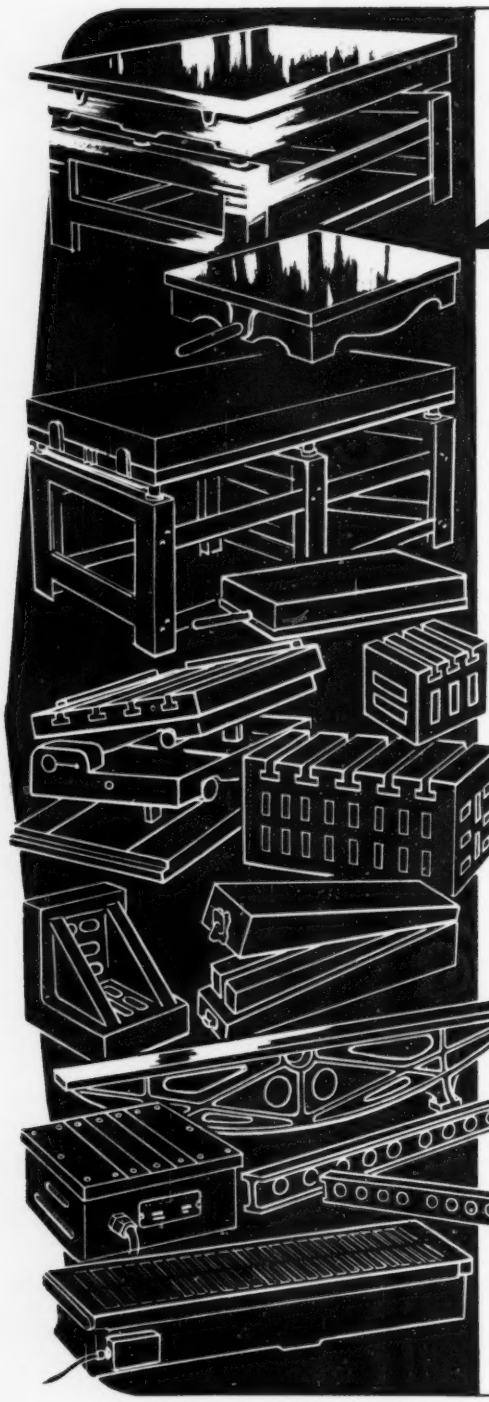

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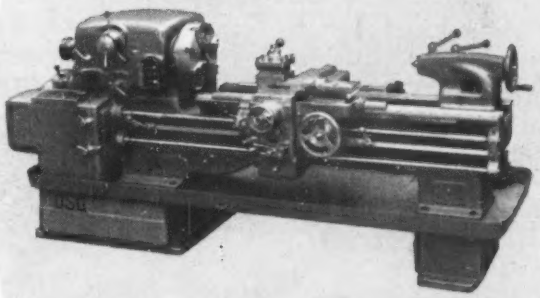

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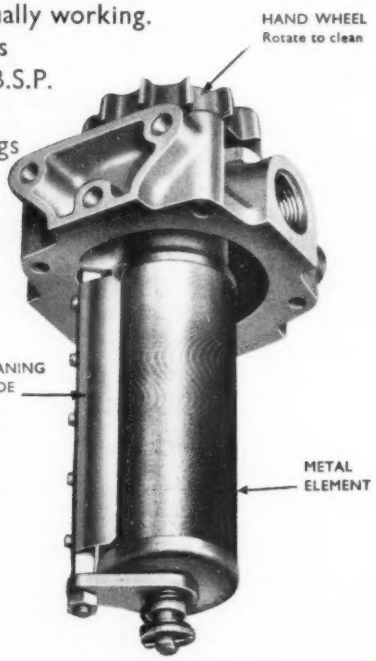

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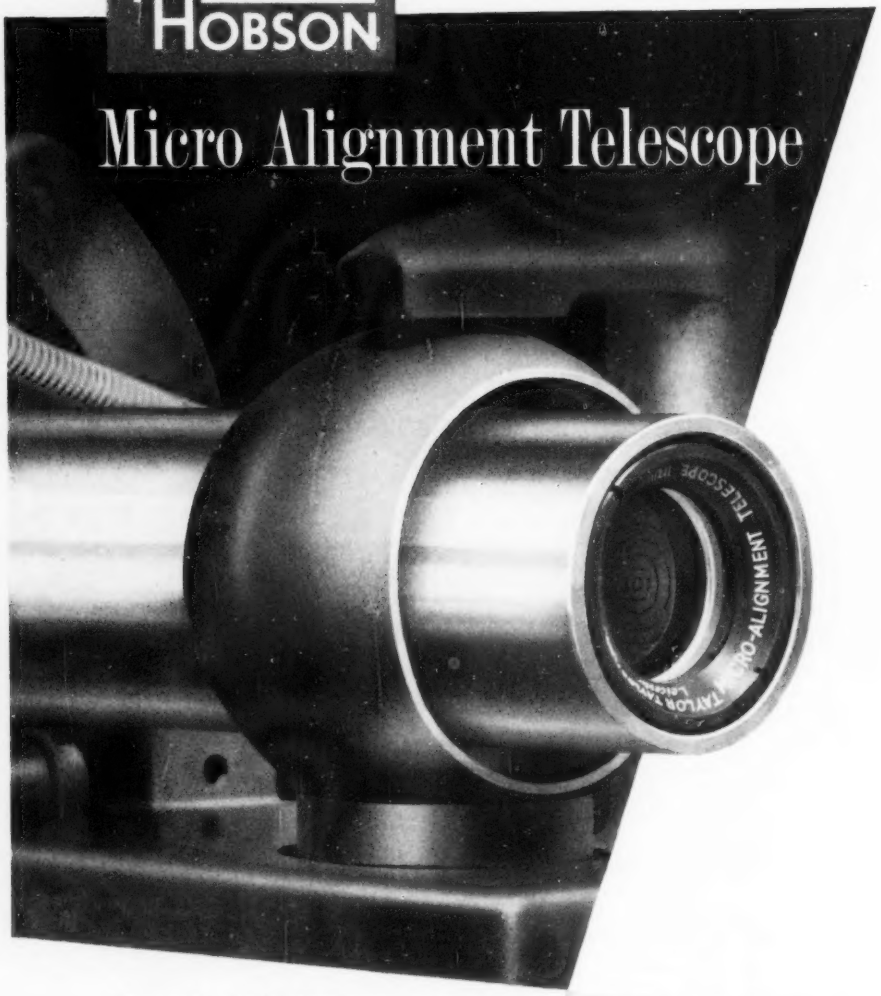

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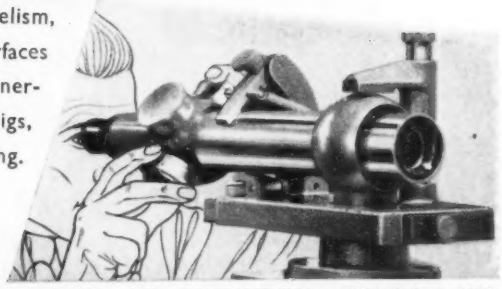

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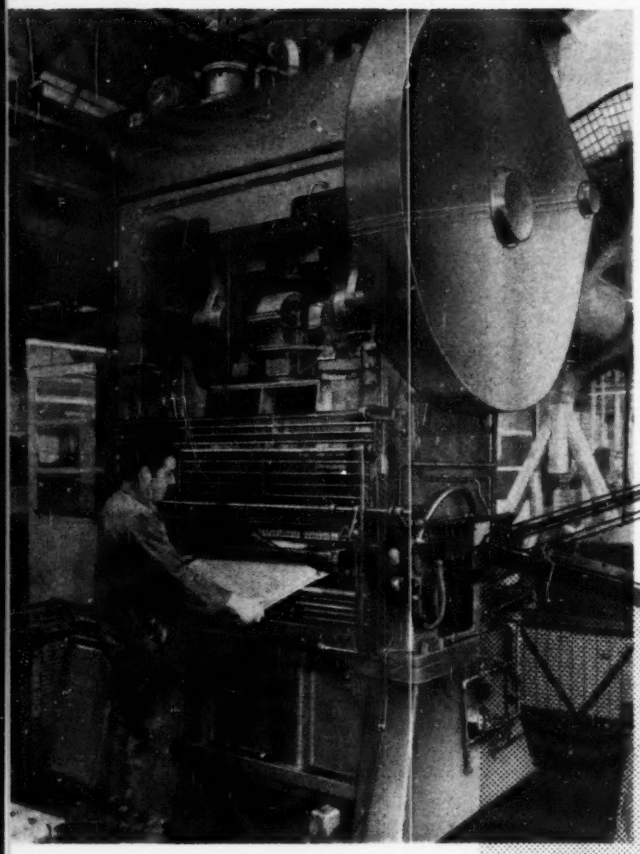
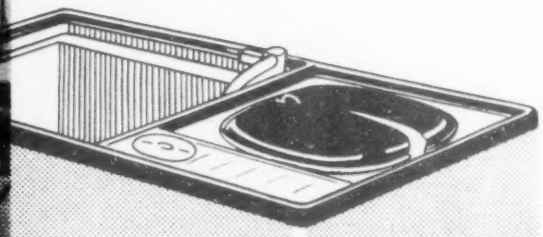


Round and about with BLISS

The ever-increasing efficiency and reliability of the production lines at Hoover (Washing Machines) Ltd., Merthyr Tydfil, result from intensive studies of advanced equipment and techniques.
A case in point is a battery of Bliss 135-ton, straight sided, double-crank presses here seen producing draining boards for Hoover's famous washing machines.



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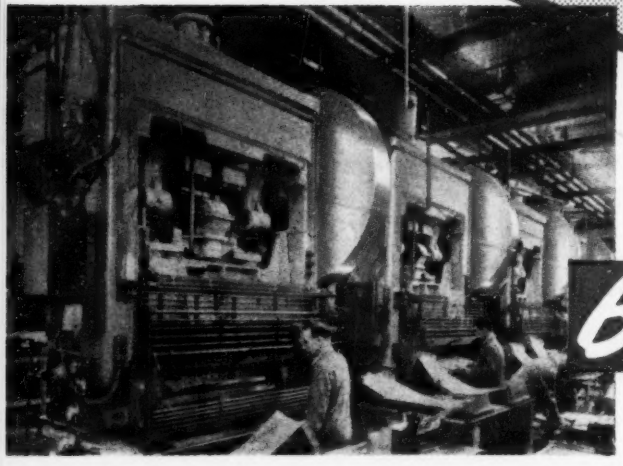

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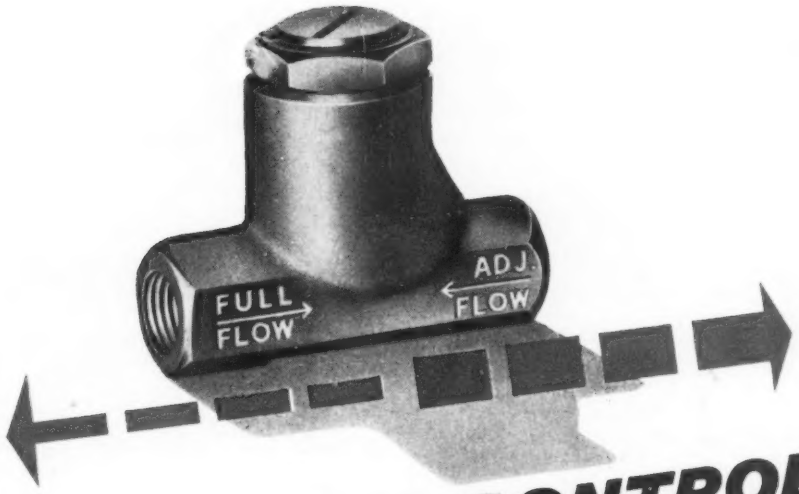

FLOW CONTROL

SCHRADER FLOW CONTROL VALVES provide a control of movement speed so essential to the effective use of compressed air equipment. The range of valves has now been extended to give even greater flexibility.

The valve is easily set, by means of an adjustment screw, thus determining how fast the air flows in the "adjusted" direction. If used in conjunction with an air cylinder, for instance, the valve can control the pressure build-up and with it the *speed* of the piston thrust, but not its pushing force. This controlled thrust speed avoids the impact shock of suddenly applied air pressure, yet permits full thrust force. When the valve is operating in the "full flow" direction a poppet is opened, giving open line pressure. Where controlled air flow is required in both directions, two valves can be fitted back-to-back.

Although designed primarily for air control, these valves are equally suitable for use with oil or water in hydraulic systems.

Body of cast brass.
Non-corrodible plunger assembly, replaceable in one unit.
Substantial lock-nut resists vibration.

The $\frac{1}{8}$" bore valve is the latest addition to the Schrader range, which now covers $\frac{1}{8}$", $\frac{1}{4}$" and $\frac{3}{8}$" B.S.P. sizes. These provide a pressure range as follows :— AIR : 0-400 P.S.I. OIL or WATER : 0-800 P.S.I.

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FLOW CONTROL VALVES

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ADDRESS .....

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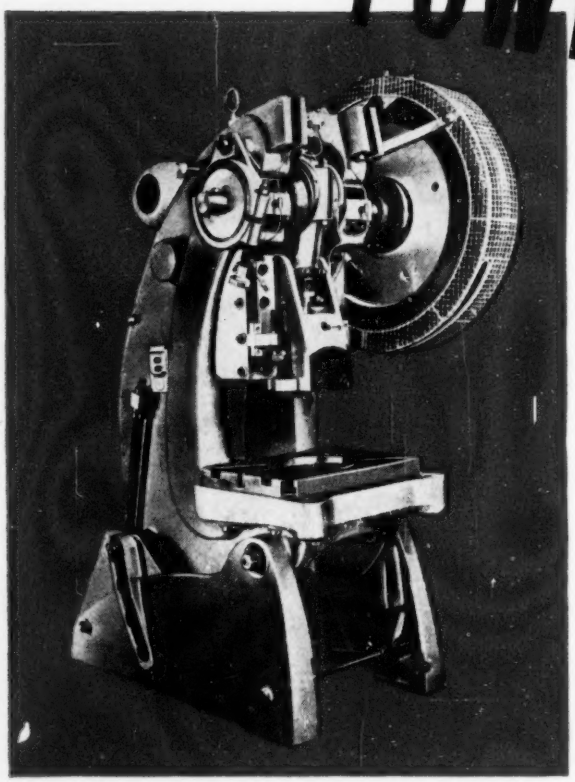

N.I. 40-ton presses will have an instant appeal to the discerning user—not only from the point of view of powerful clean design —but also for their many new and progressive features.

The solid chrome-vanadium clutch key, for instance, hinges in a knuckle joint formed in the hub, and when engaged is in direct compression only, all shear forces having been eliminated—thus ensuring a virtually indestructible assembly. Further details will gladly be sent on request, and we invite you to write to us without delay. Illustration shows ungeared model.

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	Ungeared	Geared
Max. Pressure ..	40 tons	40 tons
Strokes/min. ..	100	50
Stroke Adjustment	$\frac{1}{8}$" to 3$\frac{1}{8}$" (8 positions)	1$\frac{1}{4}$" to 4$\frac{1}{2}$" (8 positions)

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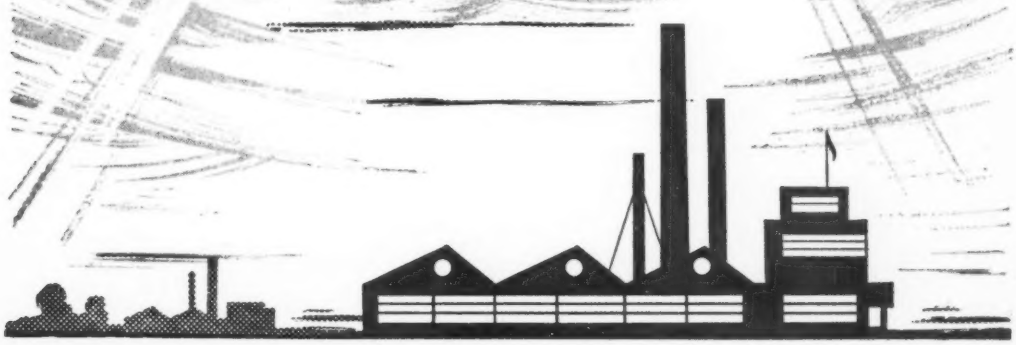

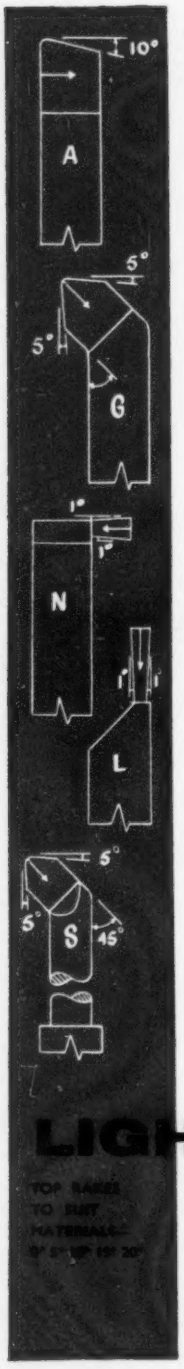

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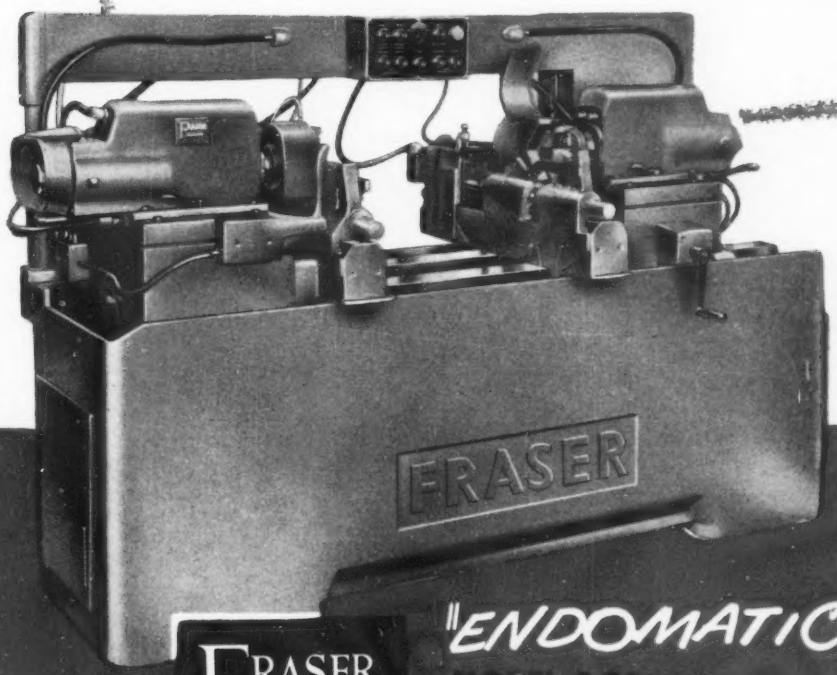

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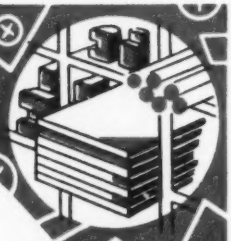

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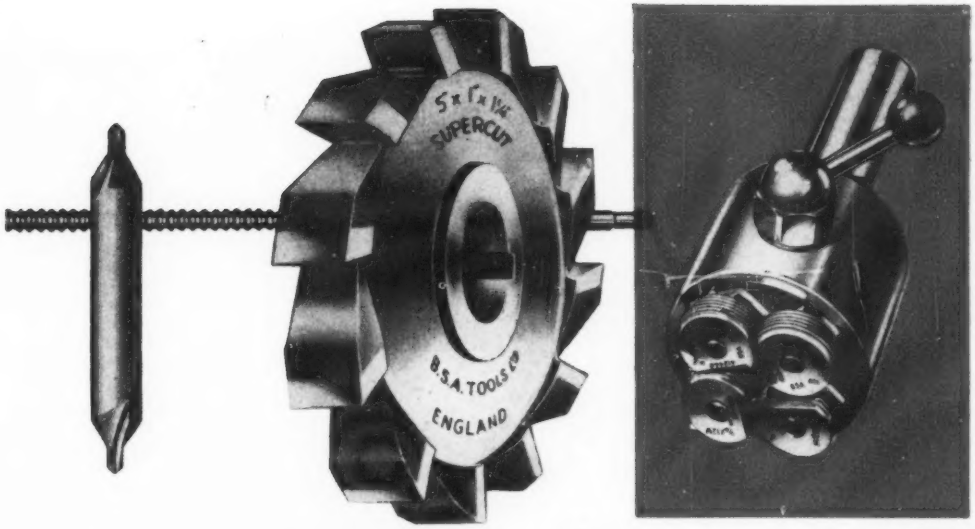

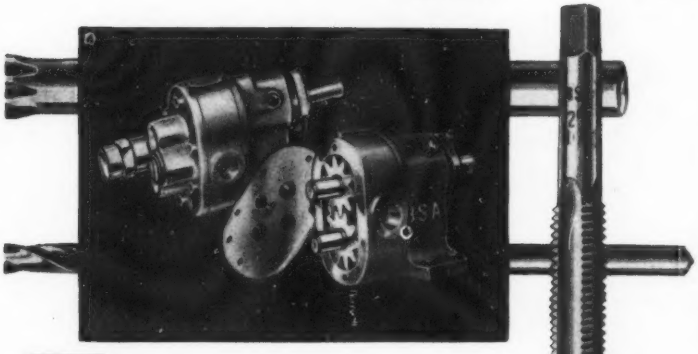

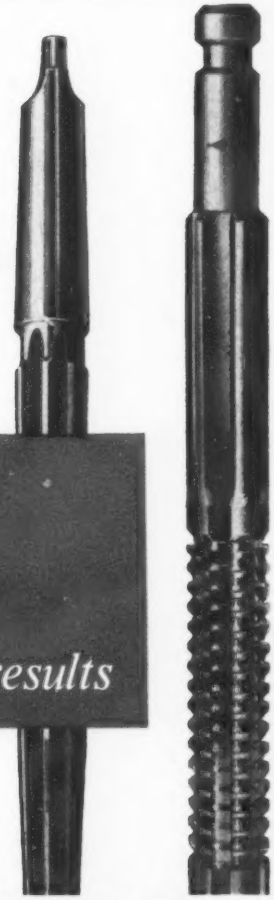

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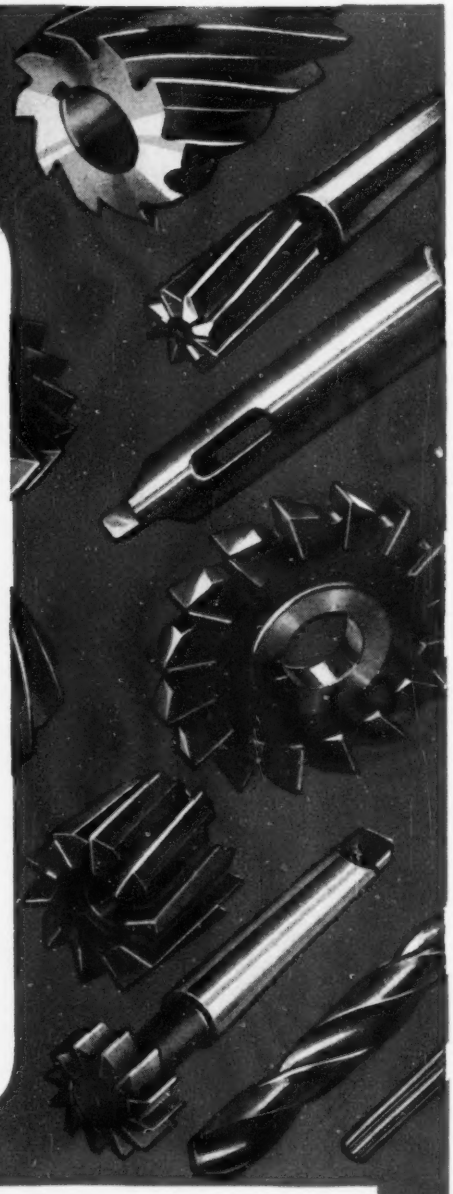

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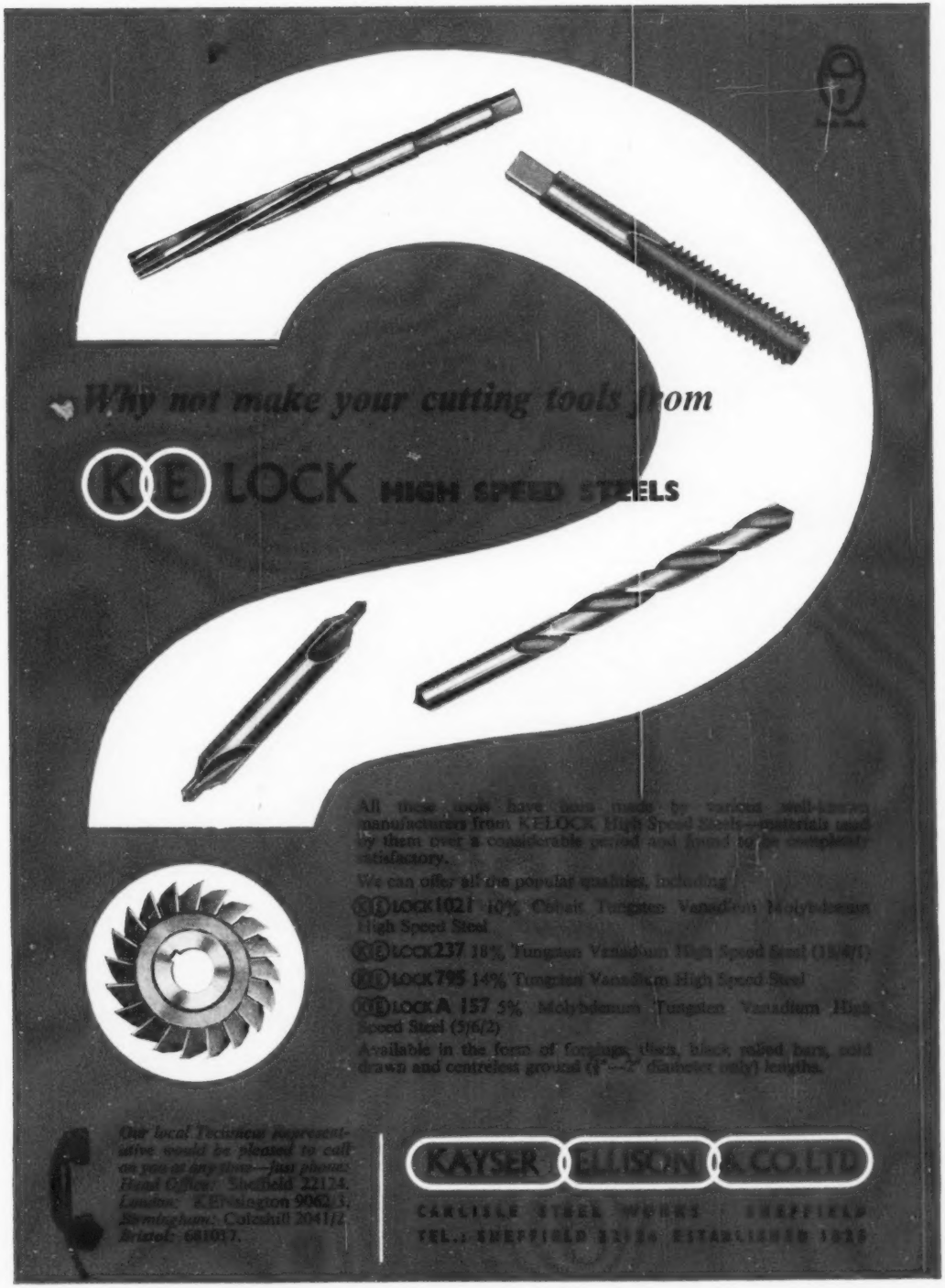
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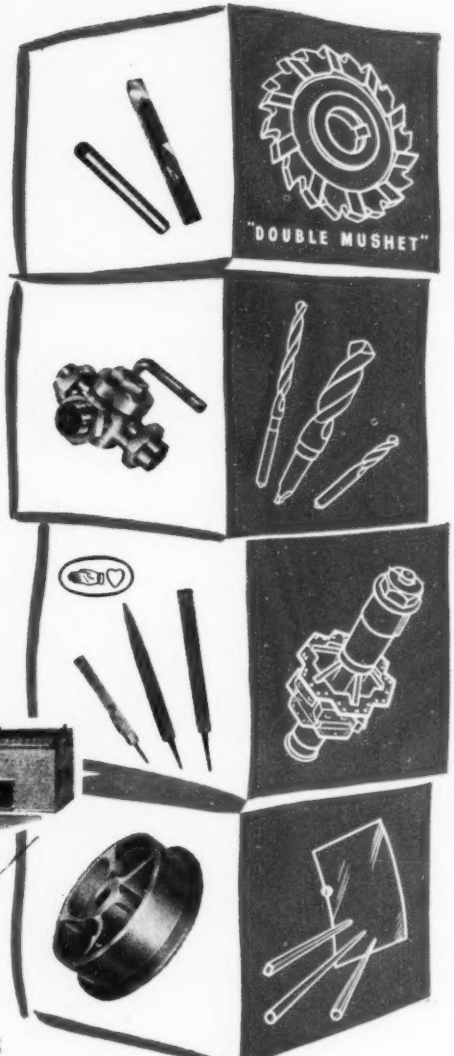

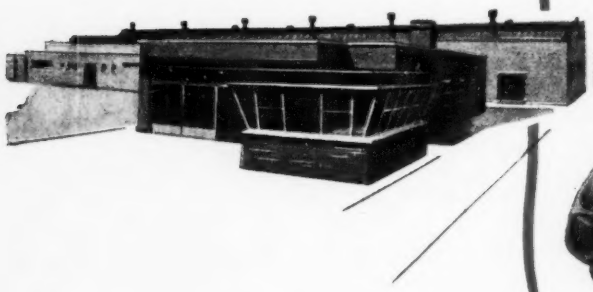

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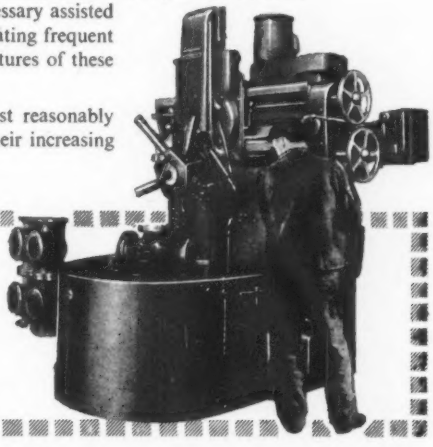
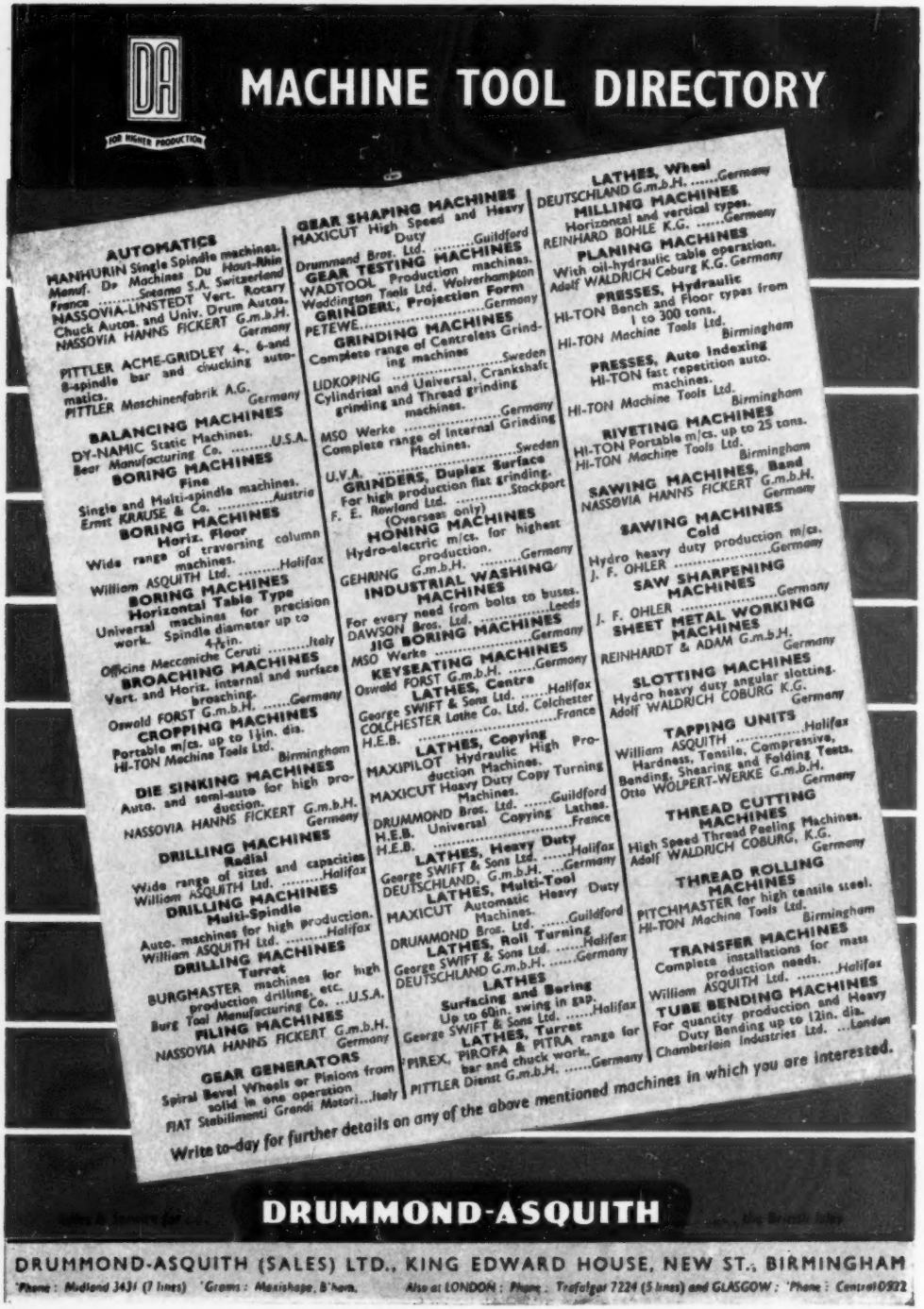
Add to this the fact that they are probably the most reasonably priced machines of their kind, and the reasons for their increasing demand become clear.



The illustration shows one of the battery of Webster and Bennett Boring Mills installed in the London Works of Dewrance & Co. Ltd., facing, turning, boring and screwing 5" valve bodies in a floor to floor time of 66 minutes.

WEBSTER & BENNETT LTD., COVENTRY, ENGLAND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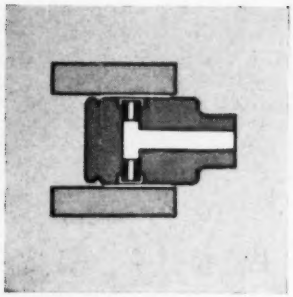

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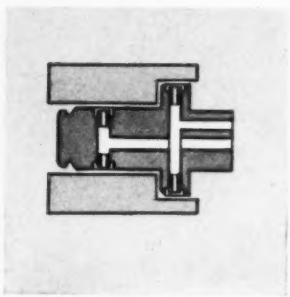

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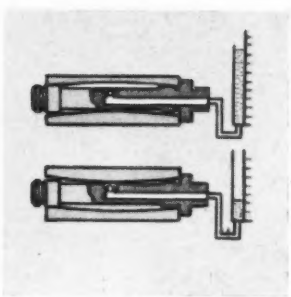

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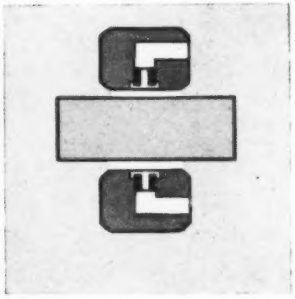

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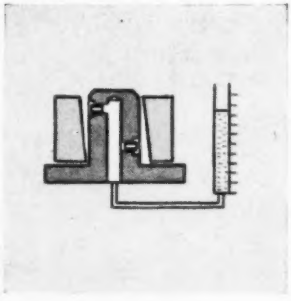

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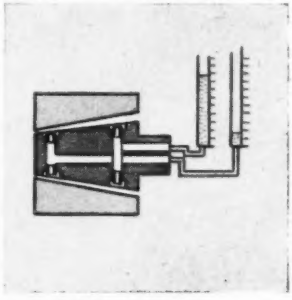

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Short comments upon published articles and letters on subjects concerning the metal working industries are particularly welcome. Payment will be made for exclusive articles.

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Abstracts of Principal Articles

Production of Ball and Roller Bearings P. 1468

In this tenth article of a series describing some of the methods employed by the Hoffmann Manufacturing Co., Ltd., Chelmsford, Essex, the assembly of ball and roller bearings in the company's "A" factory is discussed. This factory is responsible for the assembly of all bearings other than those produced on the firm's No. 1 line, and assembled in the associated Stop-Cote department, as described in the previous article. Among the various bearings assembled in the "A" factory, are roller bearings with Y-type cages, and the assembly of the cages and bearings is considered. Special-purpose Hoffmann machines, equipped for resistance heating, are employed for heating the tabs of the Y-type separators, also for pins, up to 0·25 in. diameter, fitted to 2-piece machined cages. Various hopper-fed devices are used to facilitate the insertion of balls or rollers into the cages, and in one instance, 11 balls are inserted simultaneously in a cage for a magneto-type bearing, in 4·5 sec. A Larmuth automatic machine is employed for wrapping large bearings, up to 4 ft. diameter, and will wrap an 11-in. diameter bearing in 45 sec. (MACHINERY, 93—24/12/58.)

The C.R.S.I.M. System for Machine Tool Control .....P. 1457

A simple and relatively inexpensive tape-control system for machine tools has been developed at the Centre de Recherche Scientifique, Industrielle et Maritime, Marseille, France. The control signals for the various machine motions are employed to modulate carrier signals of various frequencies, and the resulting signals are combined and recorded on a single channel commercial magnetic tape. When the tape is played-back, the signals are separated by special band-pass filters, and after rectification and amplification, are fed to selsyns, on the machine tool. Due to their small size, the selsyns are not employed to drive the machine members directly, but drive the brush carrying shafts of special fixed commutator motors connected to the traversing screws. The signals recorded on the tape can be obtained from the selsyns when an operator produces the first piece of a batch, or by other methods, one of which is based on the use of a stroboscopic vernier. (MACHINERY, 93—24/12/58.)

New Manufacturing Techniques for Hydraulic Servo Valves .....P. 1464

A method is here described for obtaining the required accuracy of relationship between the sleeve ports and spool lands for a highly sensitive servo valve. For this purpose a specially-equipped machine is employed, on which the side faces of the lands on a spool are ground to suit the ports of the mating sleeve. The latter is positioned optically, and there is a second microscope whereby the grinding operation is observed and controlled. Provision is made for adjusting this microscope by means of a micrometer and a 50 : 1 pantograph. When the land faces are corrected, after the valve has been flow tested, an Airetest indicator is employed, whereby, it is stated, metal removal can be controlled to an accuracy of ± 0·00001 in. (MACHINERY, 93—24/12/58.)

Teddington Automatic Air-gauging Equipment .....P. 1469

Designed for the automatic feed-back control of machine tools, the latest type 88 pneumatic size control unit produced by Teddington Industrial Equipment, Ltd., Sunbury-on-Thames, Middlesex, can be used with various types of gauging heads. The amplification is adjustable to cover any range from 0·001 in. to 0·004 in., and gauging may be carried out either on an "in process" or "post process" basis, according to the nature of the machine and operation. Three standard gauging heads are available, covering a wide range of work diameters, and special heads can be supplied for plunge-feed centreless grinding and internal grinding. An automatic grading machine, for taper roller bearing outer races, performs seven checks simultaneously, and segregates the work into six categories. This machine has a capacity of more than 1,200 components an hour. (MACHINERY, 93—24/12/58.)

"Gun" Drilling with Portable Power Tools .....P. 1476

The National Twist Drill & Tool Co., and the A. B. Quackenbush Co., U.S.A., have recently developed portable equipment for the production of accurate holes with target-type gun drills. A Quackenbush portable power drill is provided with a positive feed arrangement, and is fitted with an extension unit. This unit encloses the gun drill and the sleeve or chuck on the drill spindle, and incorporates a guide bush for the tool. A liquid-tight coupling is embodied for the supply of coolant to the drill, and slots in the extension permit the escape of swarf. (MACHINERY, 93—24/12/58.)

Special Baker Machine for Operations on Gudgeon Pins .....P. 1478

Baker Bros., U.S.A., have built two special purpose machines for the production of gudgeon pins, ready for the final grinding operation, from bar stock. A pair of bars is fed from a magazine at each side of the machine to a central trunnion fixture, where a length sufficient for one pin is cut from each bar, by automatic sawing units. Pairs of workpieces from the cut off stations at opposite sides of the machine are carried through a series of drilling, facing, countersinking and reaming stations, and are ejected by hydraulic plungers. The machining operations are performed by opposed multi-spindle heads, one of which has two pairs of independently-traversed, reaming spindles. (MACHINERY, 93—24/12/58.)

"Machinery" Sends Christmas Greetings to all Readers and Advertisers and Wishes them Every Success in the New Year.

Production of Ball and Roller Bearings

Methods Employed by the Hoffmann Manufacturing Co., Ltd.

In an earlier article in MACHINERY, 93/1332 10/12/58, reference was made to some of the methods and equipment employed by the Hoffmann Manufacturing Co., Ltd., Chelmsford, Essex, for the grading and selective assembly of ball bearing races produced on their No. 1 line, in an associated department known as the Stop-Cote shop. As already indicated, the No. 1 line (91/664—20/9/57 and 91/1012—1/11/57) is devoted exclusively to the machining of races for ball bearings up to 4 in. diameter, for which there is a high demand, and all bearings assembled in the Stop-Cote shop are of the pressed and riveted cage type.

The various departments concerned, including that devoted to cage manufacture for the company's entire range of bearings (92/640—21/3/58 and 92/779—4/4/58) are all situated in the "C" factory. Races for all other types of bearings, including roller bearings, in sizes up to 72 in. diameter, are produced in the "B" factory (92/1372—13/6/58). All bearings other than those handled in the Stop-Cote shop, are assembled in "A" factory, where the production and grading of balls and rollers (90/4—4/1/57, 90/680—29/3/57, and 90/1256—7/6/57) are also undertaken. In this article, some of the assembly methods employed in the "A" factory are discussed.

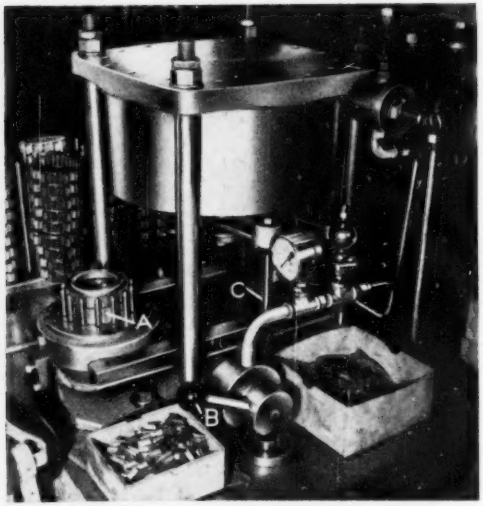


Fig. 1. At this set-up, on a Hoffmann air-operated press, the separators of the Y-type cages are assembled to one side-plate in 20 to 30 sec.

Here, bearings of sizes ranging from ½ in. to 15 in. diameter, and occasionally up to 46 in. diameter, are assembled. Because many different types of bearings are handled, the methods employed are correspondingly diverse. Basically, the procedure is as follows. Outer races are first measured and graded, and are then placed in a stores, where they are held until the inner races, ground to match, are also received. This procedure is employed because close tolerances are more readily maintained on the external track-diameters of inner races, than on the internal track-diameters of outer races. Duly identified, and accompanied by job cards with all relevant dimensional information, the races are re-issued to the appropriate departments, for assembly with selected grades of balls or rollers.

Y-TYPE ROLLER BEARING CAGES

In the first of the two earlier articles on cage manufacture, to which reference has already been made, were described the methods employed for producing the separators for Y-type roller bearing cages (92/645—21/3/58). These cages, which are of steel, are used for roller bearings of $1\frac{13}{32}$ in. to $7\frac{1}{16}$ in. diameter, and are assembled in the "A" factory. A typical set-up for the first assembly stage is shown in Fig. 1. A Hoffmann pneumatic press, with a 12-in. diameter cylinder, operated at a pressure of 75 lb. per sq. in., is employed, with the fixture seen at the left. This fixture is mounted on a slide, which is pulled towards the front, against a stop, for loading.

The fixture has a ring of equally-spaced pegs, set vertically in the base. These pegs correspond, in number and pitch, to the spacers in the assembled bearing, and mounted concentrically within them, there is a stripper ring A. The external diameter of the ring is such that it is in light contact with the inner surfaces of the pegs, and it is free to slide vertically on a central spigot. In the free position, the bottom of the ring rests

on the base of the fixture. Loading is carried out by inserting a Y-section separator between each peg and the central spigot, with the "upper" limbs of the Y straddling the peg, and the "lower" limb towards the spigot. At the lower end, each spacer is additionally located by the riveting tab, which loosely engages a hole in the top face of the stripper ring.

Once the spacers have been loaded, as described, a side-plate is placed over them, with the rectangular holes lightly resting on the rounded lead portions of the tabs at the upper ends. The side-plate is meanwhile centralized by a reduced diameter portion at the upper end of the spigot, the shoulder of which is clear of the under-side of the plate. After it has been loaded, the fixture is pushed to the rear, against a stop, and in the extreme position it trips a pneumatic valve. Unless the fixture is pushed fully home, to trip the valve, the press cannot be operated. The press is controlled by the hand-lever *B*, and the ram is fitted with an annular tool which pushes the side-plate over the tabs until it is checked by the shoulder on the spigot. This shoulder ensures that the ends of the spacers are not coined into the face of the side-plate.

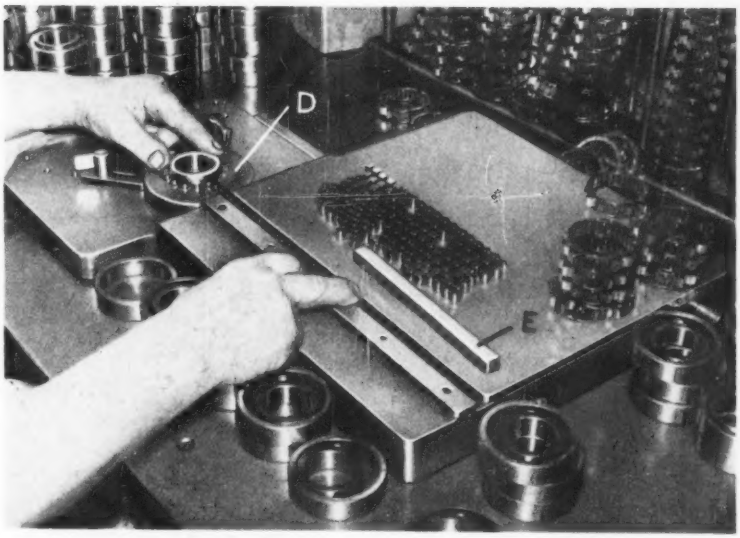


Fig. 2. The equipment here shown is employed for inserting the rollers into inner races and Y-type cages, prior to assembly of the second side-plate

During the return stroke of the ram, the work is partly ejected from the fixture by the stripper ring. The latter is actuated by pins that pass through holes in the platen and the fixture base, and are momentarily raised, and then withdrawn, by an up-stroke linkage coupled to the ram by rods, one of which may be seen at *C*. With the ram fully raised, the fixture is returned to the forward position, for unloading and reloading. The stage is completed in 15 sec. per assembly. As each assembly is completed, it is placed on a peg-type rack, and as each rack is filled, it is passed to the "building" station shown in Fig. 2. Here, the cages and rollers are assembled with the races, before the second side-plate is applied to each cage, and the tabs are riveted.

The inner and outer races are received at the building station already paired, and each inner race is removed from the outer, and placed in the fixture *D*. As will be observed, this fixture is mounted in line with a slot in a massive steel plate that serves as a work-table. This slot is periodically refilled with rollers, all arranged vertically, by the following procedure. A thick-bottomed tray, termed a "shuffle-box," is placed on the table, and is partly filled with rollers. In the bottom of the tray, there is a series of holes, of slightly larger diameter than the rollers. When the tray is gently shaken, by sliding it to and fro, a roller slides axially into each hole, so that the lower end rests on the table. The tray is then carefully lifted off the rollers, and they are left standing on the table, in rows, as seen in Fig. 2.

Transfer of the rollers to the slot is effected with the aid of an inverted channel-section scoop *E*, which is slid over the row of rollers nearest the operator, and then drawn forward over the slot, so that the rollers drop in endwise, without toppling. The fixture *D* is, in effect, a dummy outer race, and has a circular recess, with a communicating radial slot which is aligned with the slot in the table. The depth of the recess is approximately half the width of the actual race, and in the bottom—free to rotate—there is an annular member with a series of thin radial fins projecting vertically from the upper face. Equally spaced,

these fins correspond in number to the rollers in the assembled bearing.

When the inner race is placed in the fixture, it is located by the bore of the annular member, the latter, and the race, being rotated simultaneously by the operator's left hand. At the same time, the row of rollers in the slot is urged towards the fixture by the operator's right hand, and the spaces between the fins are thus filled, in rapid succession. After one complete revolution, in which all the spaces are filled, one of the partly-assembled cages is placed over the protruding upper ends of the rollers, with the lower ends of the spacers resting on the upper ends of the fins. When the assembly is lifted out of the fixture by the inner race, the rollers slide upwards between the spacers, against the side-plate, and they are thus retained in the track so that they cannot fall out. This stage is completed in a floor-to-floor time of 8 sec. per assembly.

On completion of the building operation, each assembly is inserted in the corresponding outer race,

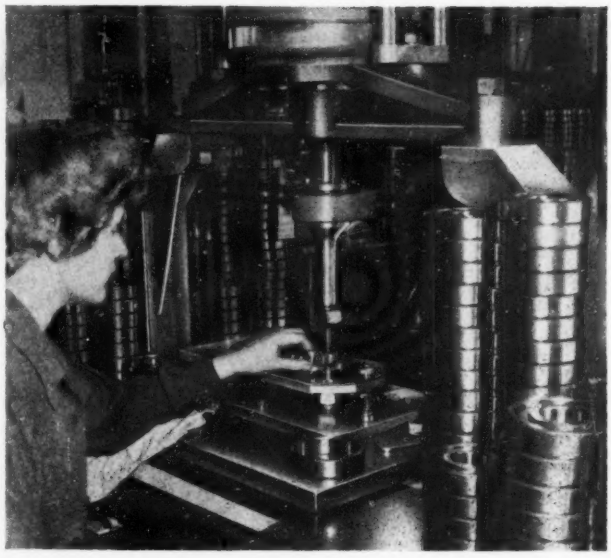


Fig. 4. This Hoffmann "electric muscle" type machine, equipped for resistance heating, is employed for heading the separator tabs on Y-type cages

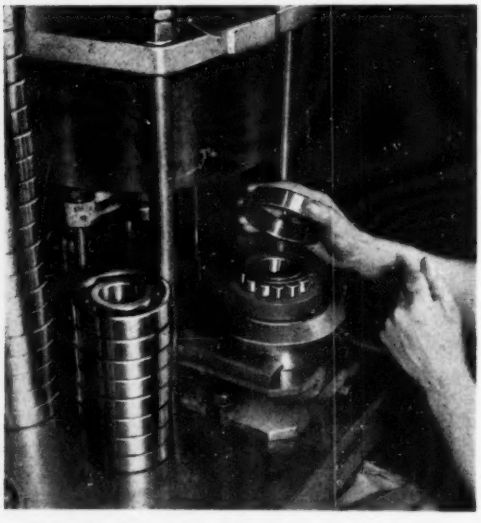


Fig. 3. Once the rollers and cage have been assembled on the inner race, the second side-plate is pressed on to the tabs of the separators at this set-up on a Hoffmann air-operated press. The fixture is mounted on slideways to facilitate loading

and is then passed to the station shown in Fig. 3, where the second side-plate is pressed on to the tabs of the spacers. The pneumatic press is similar to that used for assembling the first side-plate, and at this set-up also, the fixture is mounted on slide-ways, to facilitate loading. The assembly, comprising the inner race, rollers and cage, is located in a shallow circular recess in the top of the fixture, which receives the previously-assembled side-plate. The second side-plate is positioned on the tabs, with the latter just engaging the holes, and over the assembly is then placed a dummy outer race, as seen.

A hollow cylindrical punch, with clearance holes for the tabs, is mounted on the ram, and when the fixture is pushed to the rear, and the press is operated, the side-plate is forced home over the tabs. The travel is limited by a shoulder on the punch, which engages the upper face of the dummy outer race, and the end-clearance for the rollers is thus accurately maintained. This stage is completed in 8 sec. per assembly, and the tabs are then riveted on Hoffmann special-purpose machines of the type shown in Fig. 4. These machines are employed extensively throughout the "A" factory assembly department, and are generally similar to the "electric muscle" machines used in the firm's Stop-cote assembly shop, for pinning

and riveting two-piece pressed cages, as described in the previous article.

The machines here considered, however, are of a more advanced design, and are equipped for resistance heating and a controlled 3-stage cycle. Mechanical functions are powered by a D.C. solenoid, as on the "electric muscle" machines, and a separate A.C. circuit is provided for resistance heating. Referring to Fig. 4, the work is placed on a rest of fabric-reinforced plastics insulating material. At the left-hand end, the rest is hinged to the platen of the machine, and the opposite end is supported on a light compression spring. This spring surrounds a stud with a finger-nut at the upper end, whereby the level of the rest, in relation to a fixed riveting punch mounted on the platen, is adjusted. The level is set so that when the rest is in the free position, the under-side of the work is just clear of the punch, which projects through an aperture in the rest.

Having placed an inner race assembly on the rest, the operator aligns one of the tabs with the punch, and engages it with the rivet-head recess by lightly pressing the work, and consequently the rest, downwards. The three stages of the cycle are initiated by three movements of one handle, and an interlock system ensures that the handle cannot be moved from one position to the next, until the full period necessary for the completion of each stage has elapsed. At the first movement of the handle, the ram is lowered, and the upper punch is thereby engaged with the corresponding tab so that the work is clamped.

The next movement turns on the heating current, and once the work has been sufficiently heated, the third movement cuts off the current, and applies the heading blow by means of the solenoid. Meanwhile, the slight downward movement of the work, as the lower tab is headed, is accommodated by the support-spring of the rest. After the heading blow, the ram is raised in readiness for the next cycle, by returning the handle to the initial position. This procedure is repeated for each spacer in turn, and the stage is completed on each assembly in a floor-to-floor time of 18 sec.

RIVETING MACHINED CAGES

Machines of the type described are also used extensively for riveting 2-piece machined cages, and the particular size illustrated in Fig. 4 is designated "light automatic vertical." Larger machines, of almost identical design, such as that shown in Fig. 5, are employed for riveting pins of 0·0935 in. to 0·25 in. diameter, in the cages of some of the larger bearings. In Fig. 5, a typical 10-in. diameter bearing is seen set-up for the countersunk riveting of 11 pins of 0·189 in. diameter, which is completed in a floor-to-floor time of 32 sec. per bearing. For all work of this type, the pins are first inserted in the cages by hand, and are driven home by the use of a recessed punch and support, which ensure that the correct length of pin, for heading, protrudes from each face of the cage.

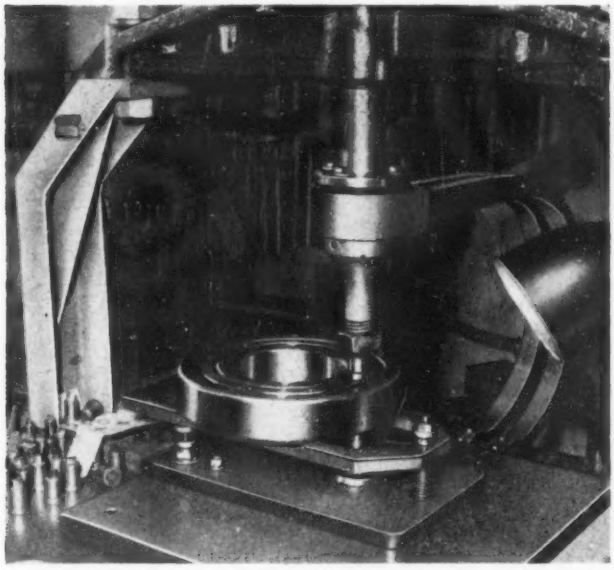


Fig. 5. Similar machines are employed for heading the pins in 2-piece solid machined cages. A typical example is here seen set-up for riveting a cage for a 10-in. diameter ball bearing

INSERTING ROLLERS AND BALLS

As already indicated, the department is responsible for the assembly of bearings of a wide range of sizes and designs. The methods employed for assembling the standard types of ball and roller bearings are generally straightforward, but for a number of other types, a variety of special-purpose equipment has been designed, for such purposes as inserting balls or rollers into cages and races. In one type of roller bearing, known as the firm's "registered design," the one-piece solid cage has the roller pockets machined axially, in

opposite side-faces alternately. On one side, the open ends of the pockets have a reduced diameter, smaller than that of the rollers. On the opposite side, the pockets are a free fit for the rollers throughout their length. Bearings of this type are assembled with the aid of the equipment shown in Fig. 6.

A small hopper, with a vertical delivery tube, is arranged over a circular recess in the base of the fixture, and located in the recess, and free to rotate, is a removable annular spacer, with five equally-spaced pockets. The bore of the delivery tube is slightly larger than the diameter of the rollers, and the height of the lower end above the surface of the base-plate is slightly greater than the roller length. This lower end is situated near one side of the recess, and in line with a pusher operated, through a linkage, by means of the lever *F*. The rollers are fed axially into the delivery tube by manual agitation of the contents of the hopper.

An inner race is inserted in the bore of the spacer, and each pocket, in turn, is indexed into line with the pusher. At each index position, the pusher is operated, and advances a roller from beneath the delivery tube, into the pocket. When all the pockets have been filled, a cage is placed over the rollers, with the free-fitting pockets downwards. The whole assembly is then lifted out of the recess and inverted, and the spacer is removed. Next, the assembly—without the spacer—is replaced in the recess, and the rollers are inserted radially into the remaining five pockets, by indexing the work and operating the pusher, in the same way as before. Finally, the work is removed from the recess, and the assembly is completed by placing over it an outer race. At this set-up, each bearing is assembled in 36 sec.

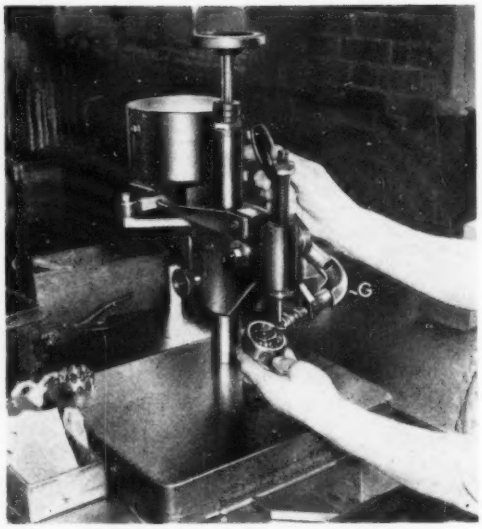


Fig. 7. Small hopper-fed arbor press, employed for inserting balls in the cages of double-row self-aligning ball bearings. A ball is delivered automatically at each stroke

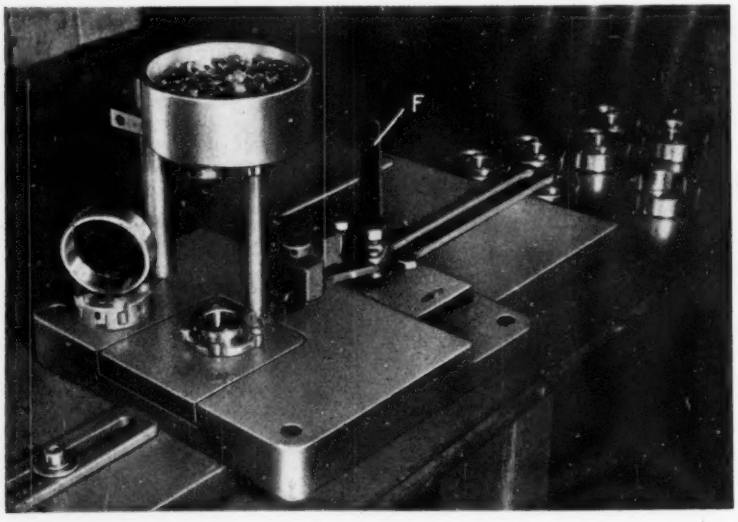


Fig. 6. This hopper-fed device is employed for inserting a total of 10 rollers in a cage for a " registered design " bearing in 36 sec.

SELF-ALIGNING BEARINGS

A typical set-up for assembling $\frac{5}{16}$-in. diameter balls into double-row self-aligning ball bearings is shown in Fig. 7. In bearings of this design, the cages are of a two-sided, solid machined type, and insertion of the balls into the pockets necessitates slight springing of the cage. As may be observed, a small machine

is employed, which resembles an arbor press, and is equipped with a hopper feed device that operates in the following manner. An inner race is located on a shouldered spigot mounted on the base-plate, and over it is placed a cage and an outer race. The spigot and the press are so arranged that the ram of the press is vertically above one side of the cage, in line with the ball pockets.

Associated with the hopper, there is a guide-tube G, the lower end of which terminates in a nozzle fitted with a pair of spring retaining claws. This nozzle is mounted immediately below a pin in the press ram, and above the work. At the beginning of the cycle, there is already a ball in position between the spring claws. The work is indexed manually to bring each ball-pocket, in turn beneath the ram, and at each index position, the ram is operated by pulling down the hand lever. A ball is thereby pushed out of the claws and into a pocket, and a shutter mechanism coupled to the lever shaft of the press releases another ball into the guide-tube. To provide the necessary clearance for inserting the balls, the outer race is tilted on the cage, as seen. The same procedure is employed for inserting the balls in both sides of the cage, and bearings with a total of 20 balls are assembled in 15 sec. each.

HOT ASSEMBLY

For certain bearings, notably those of the deep-groove, double-row, ball journal type, thermal expansion of the outer race is necessary, in order to permit insertion of some of the balls. In this type of bearing, the cage comprises two solid rings, in each of which the ball pockets are machined axially in one face. These cages are assembled "back-to-back," with the plain faces towards each other, on the centre-line of the bearing. Assembly is begun by placing the inner and outer race on a flat surface, and displacing the inner race to one side, as far as possible.

A predetermined number of balls is placed in the space between the inner and outer races, and these balls are fed into the bottom track with the aid of a probe. The number of balls that can be inserted in one track in this manner falls short of the total required, and it is for the insertion of the remainder, through the "filling" gap, that it is necessary to expand the outer race by the application of heat. Heating is performed with the aid of massive brass rings, one being seen in the foreground of Fig. 8. Two such rings are employed, to facilitiate continuous operation, and they are heated on an electric hot-plate.

In the top of each ring, there is a circular recess, which is of the same depth and diameter as the outer race, and the diameter of the bore is such that the width of the internal support-shoulder does not exceed the radial thickness of the outer race. In this manner, it is ensured that only the outer race is heated.

For the insertion of the remaining balls in the first track of the heated work, a small hopper-fed press, similar to the type already described, is employed, and this press is seen in use in Fig. 8. Once all the balls have been inserted in one side of the bearing, it is turned over, and a half-cage is placed over the spaced balls. Next, the second half-cage is loaded, and placed back-to-back against the first. The outer race is then heated again, and all the balls on the second side of the bearing are then inserted through the filling gap, beneath the press. Typical bearings with 12 balls per side, can be assembled by a skilled operator in an average time of 1·2 min. each.

Fig. 8. Typical equipment for the hot assembly of deep-groove double-row ball journal bearings. Thermal expansion of the outer race permits insertion of the balls

MAGNETO-TYPE BEARINGS

In the magneto-type bearings produced by the company, the balls are held in channel-section solid cages, in which the pockets are machined radially. These pockets are a "snap-on" fit for the balls, and for inserting the latter, the small hopper device shown in Fig. 9 is employed. A cage is placed in a recess in the underside of the support-plate, and all the balls are inserted simultaneously at a single stroke of a hand lever. In a typical cage for ¾-in. diameter balls, the 11 balls are inserted in 4·5 sec. In Fig. 10, the hopper is shown removed from the stand and inverted, with the bottom plate *H* detached, to enable details of the design to be observed.

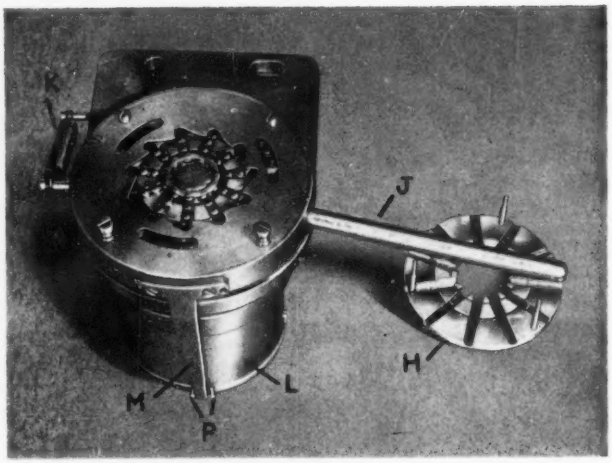


Fig. 10. The equipment in Fig. 9 is here shown partly dismantled, to enable details of the design to be observed. The balls are inserted simultaneously with one stroke of the lever *J*

In a boss on the underside of the support plate there is a ring of equally-spaced, vertical, holes, corresponding in number to the pockets in the cages. The pitch-circle diameter of these holes is somewhat greater than the diameter of the locating recess, and is such that they lie just outside the perphery of a secondary boss, concentric with the main boss. A semicircular slot, machined radially in the secondary boss, connects the bottom of each vertical hole with the central locating recess, and these slots, in conjunction with similar slots in the bottom plate *H*, form tunnels through which the balls are fed into the recess. The length of each tunnel, including the portion directly below the vertical hole, is such that it will accommodate three balls, touching each other.

Fig. 9. Cages for magneto-type bearings are filled with 11 balls, of ¾ in. diameter, in 4·5 sec. each, with this manually-operated hopper-fed equipment

Surrounding the main boss, there is a ring which can be turned by means of the finger lever *J* against the tension of the spring *K*. To the bottom face of this ring is attached a cam-plate of the same thickness as the secondary boss, with a central profiled aperture into which the secondary boss projects. The profile comprises a series of projections of ratchet-tooth form, which correspond in number to the vertical holes in the support-plate. The end of each tooth just clears the edge of the secondary boss, and in the free position of the cam-plate assembly, the bottom of the space between each pair of adjacent teeth is in line with one of the vertical holes. In this position, also, the radial face of each tooth forms a continuation of one

side of the corresponding radially-disposed tunnel.

The vertical holes in the support-plate communicate with the hopper, which is rotatably mounted on the support-plate. When the hopper is first filled, the lever *J* is given a few strokes, whereby the cam-plate assembly is oscillated. This movement is transmitted to the hopper *L*, through the arm *M* attached to the ring, and the two pins *P*, so that the contents are agitated. Consequently, balls are fed from the hopper into the radial tunnels. Once the tunnels are filled and a cage is inserted in the locating recess, movement of the lever *J* in a clockwise direction causes the inclined faces of the teeth to urge the balls in each tunnel towards the work. The necessary pressure for inserting a ball in each pocket is transmitted through those lying in the tunnel. When the lever is released, and the cam-plate returns to the free position, a further set of balls is released from the hopper into the entry ends of the tunnels, in readiness for the next working stroke. To ensure that the balls are not forced through the pockets, there is a central spigot in the locating recess, which serves as a stop.

WASHING AND PACKAGING

The routine to which the bearings assembled in the "A" factory are subjected, on completion, is generally similar to that followed in the "W.I.T.P." department associated with the Stop-Cote assembly shop, and described in the previous article.

To facilitate washing the smaller bearings in paraffin, equipment designed and built by the company is used. Each bearing to be washed is placed on a spigot that engages the bore of the inner race, and a series of jets is directed on to the balls and cage at an angle, with the result that the balls and outer race are driven round. Meanwhile, the paraffin is filtered and recirculated continuously, and thorough cleaning of the bearings is thus ensured.

After they have been washed, the bearings are inspected, tested, oiled or greased, and packed. The smaller bearings are normally oiled, and packed in convenient quantities, but the larger types, of 11 in. diameter and over, are wrapped individually. Prior to wrapping, each such bearing is subjected to a careful preservative treatment, whereby it is first wiped externally, by hand, with clean material, in order to remove all moisture and finger prints that could give rise to corrosion. Next, the work is immersed in a bath of molten mineral jelly, at approximately 175 deg. F., in which it is left until all the entrapped air has been expelled, and the bearing is thoroughly heated.

On removal from the bath, the bearing is allowed to cool to room temperature, and it is then rapidly dipped in the same bath, and quickly removed, so that it is completely sealed by a further coating of mineral jelly, 0·040 to 0·050 in. thick. A layer of white waxed paper is first wrapped circumferentially round the outer race, by hand, and the edges are turned over and smoothed against the sides. This covering is then bound round with a continuous strip of white waxed paper, followed by a similar strip of brown waxed paper, on the Larmuth automatic machine shown in Fig. 11. Bearings up to 4 ft. in diameter are accommodated on this machine which resembles those commonly employed for taping electrical field coils, and operated on a similar "gap-ring" principle.

The bearing to be wrapped is supported on a pair of drive-rollers *Q*, and is steadied by the adjustable idle rollers *R* and *S*, which engage it on either side. When the automatic cycle is initiated, paper tape is wound off the spool *T* on to the gap-ring *U*,

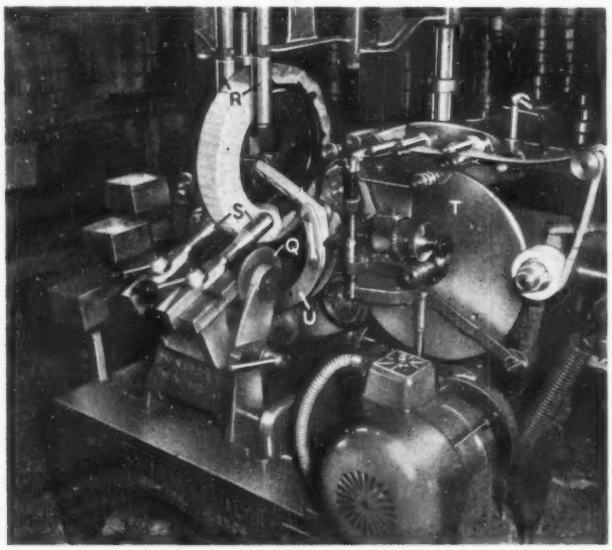


Fig. 11. This Larmuth automatic wrapping machine will accommodate bearings up to 4 ft. diameter, and will wrap an 11-in. diameter bearing in 45 sec.

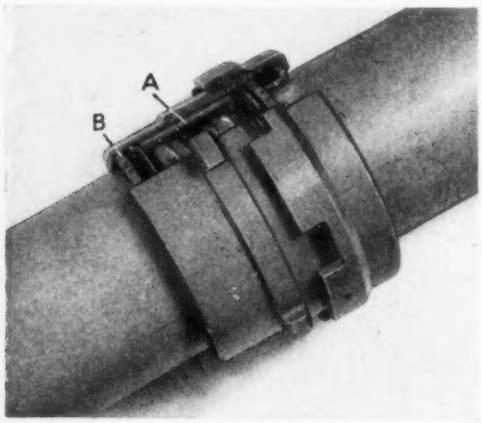
and when the required length has been wound on, the tape is severed by a guillotine. Thereafter, it is wound off the gap-ring on to the work, and the latter is meanwhile rotated by the drive-rollers *Q*. When all the tape has been run off the gap-ring, the machine stops, and the wrapped component is removed. On this machine, an 11-in. diameter bearing is wrapped in a floor-to-floor time of 45 sec., and for larger bearings the time is proportionately longer.

Some of the activities of the firm's research and development department, and their new, recently-completed research building, will be discussed in a later article.

Aero Controls ACFlex Couplings

The part-sectioned coupling here shown is one of a range which has been introduced by Aero Controls, Ltd., Industrial Estate, Weedon Road, Northampton. Known as ACFlex couplings, these units ar intended for use in pipe systems which are subject to vibration, and it is claimed that they avoid the need for the flexible metal bellows normally provided in such circumstances. The couplings can be used as slip joints, and in addition to accommodating misalignment between the two pipes up to $\frac{1}{16}$ in., permit them to be moved axially and flexed through four deg. on either side of the nominal centre line.

Pipes to be joined by this type of coupling are prepared with swaged beads at the ends. Firstly, the nut and body are assembled on to the pipes, and split rings are fitted, as indicated at *B*. Next, the O-rings are assembled, and, finally, the split lantern ring, shown at A, is placed in position to span the two beads and serve both as a retainer for the pipes, and as a spacer between the seals. The nut and body members of the coupling are then screwed together.



An example from the range of Aero Control ACFlex pipe couplings

Suitable for use in fuel, hydraulic, pneumatic, lubrication, and marine pipe systems, the couplings will operate at pressures ranging from −11 to +125 lb. per sq. in., and at temperatures from −50 to +70 deg. C. Since the couplings can be installed when the pipes are already in place, the assembly apertures provided in castings and bulkheads, for example, need be only slightly larger than the standard bead on the pipe. Normally made from BSS L.64 material, these couplings can be suppied in stainless-steel if corrosive fluids are to be handled.

A wide range of fittings of various types is available, in sizes to accommodate pipes ranging from ¾ to 3 in. diameter, in ¼-in. increments, also 3½, 4, and 5 in. diameter. A second, smaller, range of similar fittings for ⅜-, ⅝-, ½-, and ⅝-in. diameter pipes, is also available.

OPEN-CIRCUIT TELEVISION CAR-TESTING EQUIPMENT—The first licence to be issued by the G.P.O. for an open-circuit television system for industrial use has been granted to Vauxhall Motors, Ltd., for use in connection with their test site at Chaul End, which is close to the Luton and Dunstable factories.

This equipment, which is being used to study the behaviour of certain parts of commercial vehicles and cars, in motion, comprises a camera mounted adjacent to the part under observation and a small transmitter within the body or cab of the vehicle. An aerial on the roof of the vehicle transmits to another aerial mounted on the roof of the research laboratory on the perimeter of the test track. Engineers in the laboratory can then observe the behaviour of the part on a conventional television receiver. The equipment has already been used to investigate the cause of intermittent localized vibration which occurs on some vehicles at critical speeds, and it is planned to use it for the study of such items as springs, shock absorbers, propeller shafts, and other "difficult to see" components.

A closed-circuit television system has been employed by Vauxhall Motors for the past two years, but since the screen must then be carried within the vehicle under test the number of observers must usually be restricted to two, and it is for this reason that the open-circuit equipment has been provided.

The C.R.S.I.M. System for Machine Tool Control

A simple and relatively inexpensive tape control system for machine tools has been developed by Mr. V. Gavreau, Mr. A. Calaora and Mr. M. Miane, of the Centre de Recherche Scientifique, Industrielle et Maritime, Marseille, France. This system is based on the use of a standard tape recorder, with a magnetic tape of the normal width (6·3 mm.), instead of the more expensive multi-channel recording units, with wider magnetic tapes, which are frequently employed. The system has been designed for the control of fairly simple machine tools engaged in the production of workpieces in small batches, and it is protected by a number of patents.

It is anticipated that, generally, when this system is used, the first workpiece in a batch will be produced by an operator, and the movements of the various machine elements will be recorded on the single-channel tape. When this tape is played back, for making the rest of the batch of parts, the various motions of the machine are repeated as for the first workpiece.

RECORDING ARRANGEMENTS

The system may best be explained with reference to the control of a centre lathe, and the recording arrangements are shown diagrammatically in Fig. 1. Operating handles for the saddle and cross-slide are indicated at H_1 and H_2, respectively, and the traversing screws associated with these handles are coupled to the input shafts of the selsyns S_1 and S_2. The outputs from these selsyns (indicated by f_1 and f_2) vary in frequency and phase to correspond to the speed and direction of rotation of the two traverse screws, and could be recorded on separate channels of a multi-channel magnetic tape, through a suitable system. In this instance, however, each output is fed into a modulator M, to which the outputs from two oscillators O_1 and O_2 are also supplied. Each oscillator output is of a predetermined frequency—for example, 1,500 cycles per sec. for O_1 and 2,000 cycles per sec. for O_2—and this carrier frequency is modulated by the output from the associated selsyn. The provision of a number of suitably separated carrier frequencies does not present any difficulties, and the frequencies that can be recorded with standard equipment range from about 1,000 to 6,000 cycles per sec.

Output signals from both modulator units are fed to the recording head of the tape recorder T. The magnetic tape employed is of a standard type, without perforations, and the motor of the recorder does not necessarily run at an absolutely constant speed. For this reason, a further signal is fed into the recording head to provide a reference frequency. This signal consists of a carrier frequency of 1,000 cycles per sec., derived from the oscillator O_R, which is fed into a modulator and modified by a 50-cycle signal derived from the supply mains. The three signals are recorded by the single-channel magnetic tape as one complex signal. An experimental set-up for recording the movements of a lathe cross-slide and saddle is seen

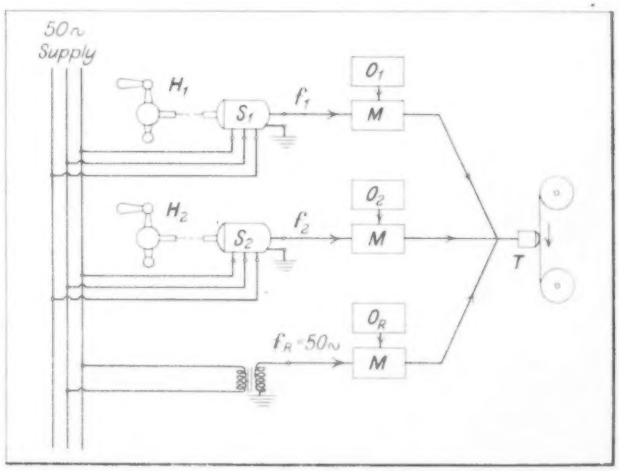


Fig. 1. The movement recording system employing a single-channel magnetic tape, which has been developed by the Centre de Recherche Scientifique, Industrielle et Maritime, Marseille, is here shown diagrammatically

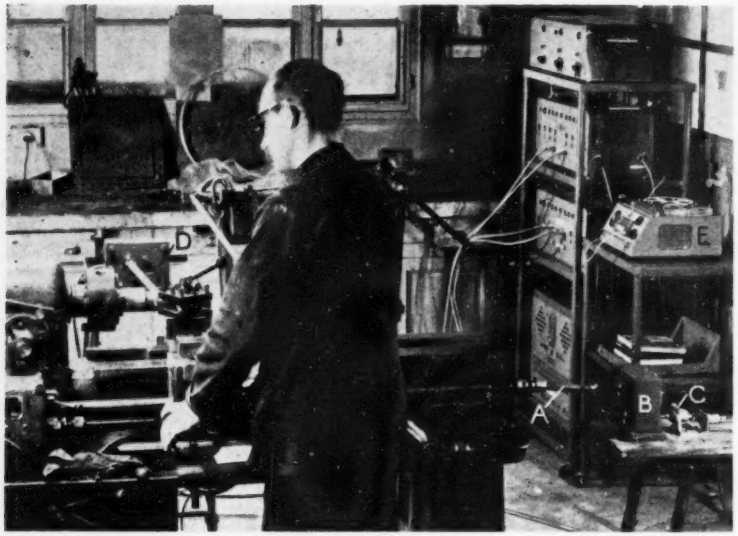


Fig. 2. The experimental set-up here shown was employed for recording the movements of the cross-slide and saddle of a centre lathe by means of the C.R.S.I.M. system

In the background, may be seen the tape recorder *E*, and beyond it the modulators and oscillators employed for generating the reference and carrier signals required for recording the machine movements.

in Fig. 2, and the operator is engaged in turning a simple stepped shaft. The machine is so arranged that all longitudinal movements are obtained by rotating the leadscrew, and the latter is connected by a shaft *A* and universal joints to the gearbox *B*, and the ratio of the speeds of the input and output shafts is 1:12. Coupled to the shaft of the gearbox is a very small selsyn *C*. Generally similar arangements are provided for the cross-slide traverse screw, and in order not to impede the movements of the operator, the gearbox is mounted at the rear of the machine bed, as indicated at *D*. The connecting shaft, however, is telescopic to allow for longitudinal movement of the slide.

PLAY-BACK SYSTEM

In Fig. 3 are shown diagrammatically the arrangements for operating the lathe under the control of the tape that has been recorded, so that it automatically performs the movements originally carried out by the operator. The tape is played-back by the recorder *T*, and the complex electrical signal provided is fed to three special band-pass filters indicated at F_1, F_2 and F_R. These filters are of a type that has been developed by C.R.S.I.M. Protected by patents, they are very simple and their cost is very small. The filters separate the output from the tape recorder into its three components ($O_1 + f_1$, $O_2 + f_2$ and $O_R + f_R$), and each component is fed into a detector stage, as indicated at D_1, D_2 and D_R. From the stages D_1 and D_2, output signals (f_1 and

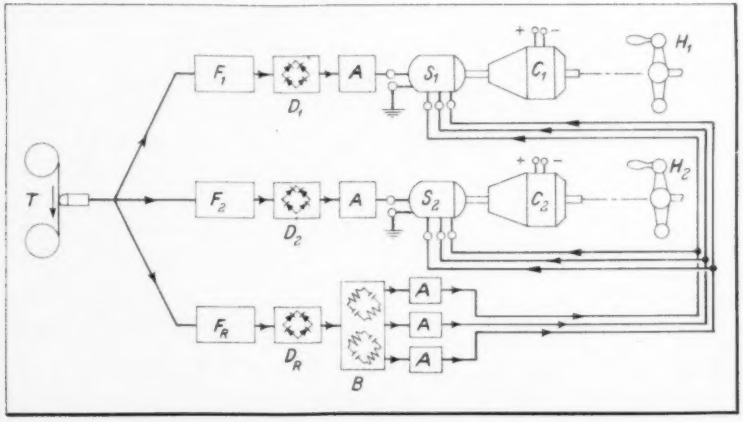


Fig. 3. Diagrammatic layout of the arrangements for playing back the tape recorded by the C.R.S.I.M. system and for applying the signals to control the motions of a machine tool

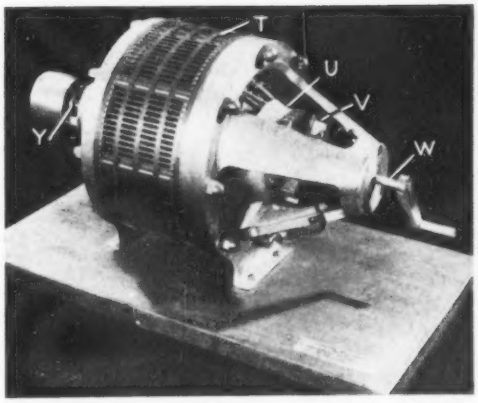


Fig. 4. A fixed commutator motor, of the Gramme-ring type, which is used in the C.R.S.I.M. system as a means of power amplification

f_2) are fed into amplifiers A, and the single-phase control currents produced are applied to the rotors of the selsyns S_1 and S_2.

The output (f_R) from the detector stage D_R is fed into the bridge network B and each phase of the resulting 3-phase output current is amplified and applied to the stators of the two selsyns. In consequence, the basic speed of rotation of the selsyns is the same as that employed when movements of the machine members were recorded, regardless of any slip that may occur in the tape, or variation in speed of the recorder.

FIXED COMMUTATOR MOTORS

Since the two selsyns used are small, and each has an output torque of only 300 gm.-cm., it is necessary to employ some form of power amplification to obtain torques of sufficient magnitude to operate the motions of the machine, the operating handles for which are indicated at H_1 and H_2 in Fig. 3. It is also essential that the rotation of the traverse screws of the machine should be in phase with the rotation of the shafts of the selsyns, and recourse is had to "fixed commutator motors" for power amplification purposes.

These motors are indicated at C_1 and C_2, and a general view of one such motor, with certain covers removed, is given in Fig. 4. Of the Gramme-ring type, the motor has a stator T, the windings of which are connected to the fixed commutator U. Through slip rings, a supply of direct current is connected to the brushes V, which are mounted on a shaft W. The arrangement is shown diagrammatically in Fig. 5, which is lettered to correspond with Fig. 4. When the shaft carrying the brushes is rotated, the windings of the stator are each, in turn, connected to the power supply, so that a rotating field is created. The rotor X, within the stator, consists of a simple electro-magnet. As the shaft W is turned, the rotor follows the rotating field of the stator, and the rotor shaft Y turns in synchronism with the shaft W.

In the C.R.S.I.M. system, the selsyns S_1 and S_2, Fig. 3, are connected to the brush-carrying shafts of the fixed commutator motors C_1 and C_2, as shown in Fig. 6, where a selsyn is seen at S and a motor at C. In this instance, the motor is supplied with direct current (of 32 volts, 10 amp.) from the transformer and rectifier system below, but very powerful motors of this type can be built without difficulty. The output torque of the selsyn is more than sufficient to drive the brush-carrying shaft, and the output shaft can run in either direction, at speeds up to 800 r.p.m., in phase with the selsyn shaft. Moreover, the input and output shafts can be stopped without risk of damage to the windings. The power delivered by the output shaft may be very substantial, and the arrangement may be

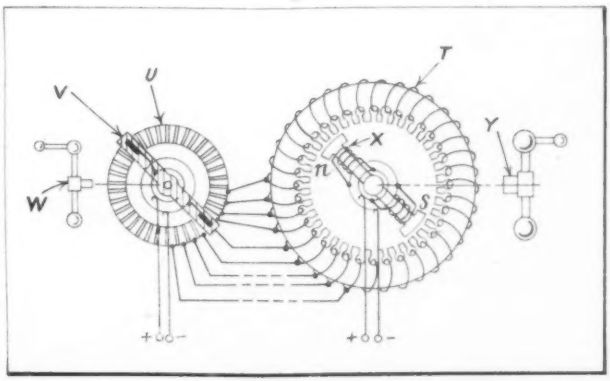


Fig. 5. Schematic layout of a fixed commutator motor. The stator windings are supplied with D.C. by means of a commutator and a rotating brush assembly, which is driven by a selsyn. The rotor takes the form of an electro-magnet and follows the rotating field of the stator

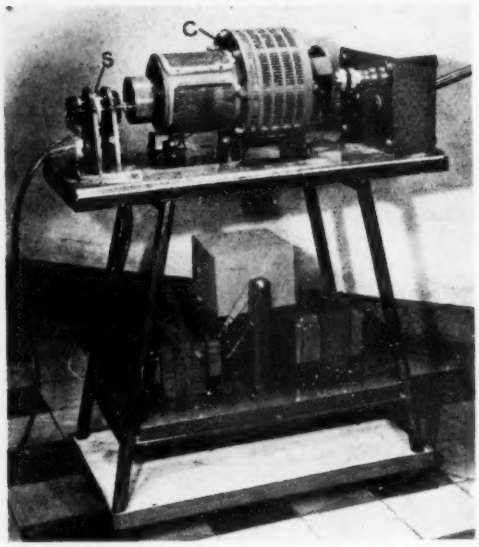


Fig. 6. The arrangement of the fixed commutator motor and its associated selsyn is here shown. A reduction gearbox is coupled to the output shaft of the motor, and a rectifier for the D.C. supply to the stator is mounted below

employed where it is necessary to provide a drive of high torque, at speeds ranging from 0 to 800 r.p.m., with a precise relationship between the output speed and that of another shaft.

Fig. 7 shows the experimental tape-controlled lathe, with the tape recorder and its associated equipment in the background. The two fixed commutator motors are indicated at *C*, and it may be observed that their output shafts are connected by reduction gearing to universally-jointed shafts, which are coupled to the traverse screws of the saddle and cross-slide. Care is taken to arrange the shafts so that any angular errors introduced during their rotation cancel out similar errors that occurred when the movements of the saddle and cross-slide were recorded.

APPLICATION TO COPY MILLING

The C.R.S.I.M. system can be applied to the control of milling machines, for example, for the production of complex forms. Various methods may be adopted, and one arrangement is shown in Fig. 8. The compound table *A* can be moved on accurate guideways, in two directions at right angles, by hand-actuated traversing screws. The handwheel of one screw is being manipulated by the operator's left hand in Fig. 8, and with his right hand he manipulates a similar handwheel, for the other screw. Each screw is coupled to a gearbox by a universally-jointed, telescopic shaft, and the output shaft of the gearbox is connected to the input shaft of a selsyn. A drawing of the form to be produced (or, preferably, a photographic reproduction of large-scale drawing) is secured to the table *A*, and the outline is viewed by the operator through the microscope mounted above. The microscope is provided with a crossed-line graticule, and the magnification is such that graticule lines can readily be brought into coincidence with the outline of the drawing within an accuracy of 0·01 mm. (0·0004 in.). By manipulating the two handwheels, the operator can traverse the table so that the drawing outline is scanned by the graticule, and the table movements are converted by the selsyns into electrical signals. These signals are employed to modulate carrier oscillations and the resulting signals, together with a reference signal, are recorded on a single-channel magnetic tape, in the manner already outlined.

Subsequently, the recorded signal can be employed to control a milling machine or other production unit. If it is necessary to machine a profiled workpiece from a rough blank or forging in several cutting passes, the path of the tool for each pass can be superimposed on the drawing, and the various roughing and semi-finishing traces recorded, in addition to the final tool path. Provisions can be made for tool changing and the engagement of different feed and speed rates, as will be explained later.

STROBOSCOPIC VERNIER SYSTEM

Although selsyns must be employed to operate the various motions of a machine tool under the C.R.S.I.M. system, such units need not be employed for recording the tape. For example, the necessary variable-frequency signals can be obtained from a "stroboscopic vernier," and the arrangement is shown diagrammatically in Fig. 9. The small synchronous motor *B* drives the disc *C* at a constant speed of 1 revolution per sec. Extending inwards from the periphery of the disc are 50 equally-spaced slots and teeth, and there is a similar disc *D*, which is mounted on a shaft co-axial with that of the motor. The shaft of the disc *D* is connected by a telescopic universally-jointed shaft *E* to the traverse screw (in this instance

indicated by the handle *F*), the movements of which it is desired to record.

Light from a lamp *G* is condensed by the lens system *H*, and the parallel beam thus produced is projected through the slots in the discs *C* and *D* on to a photo-electric cell *J*. Since the disc *C* has 50 slots and is rotated at 1 rev. per sec., an electrical signal with a frequency of 50 cycles per sec. is generated by the cell *J*, as long as the disc *D* remains stationary. If the traverse screw is rotated so that the disc *D* turns in the same direction as the disc *C*, the frequency of the signal from the cell *J* in increased. If the traverse screw and the disc *D* are turned in the opposite direction, the frequency of the signal is decreased. The effect is similar to that obtained when a selsyn is used for recording, except that the increase or decrease in frequency is not in direct proportion to the variation in the number of revolutions per sec. of the disc *D*, but to the displacement of the slots in the disc. Since the speed of the machine-operating selsyn is directly proportional to the frequency of the signal, it will make one additional revolution for a movement of the disc through 1/50 of a revolution. In consequence, the stroboscopic vernier is 50 times more sensitive to angular variations than is the selsyn recording system.

Instead of using two slotted discs arranged as shown in Fig. 9, it is possible to employ the system shown diagrammatically in Fig. 10. In this example, it is required to reproduce the surface *K*, which is passed beneath the stylus of a sensitive comparator *L*. The indicating pointer of the comparator is replaced by a lightweight disc *M*, in which there are 50 radial slots. A second slotted disc *N* is mounted on the shaft of a small synchronous motor *P*, and is driven at a speed of 1 revolution per sec. The disc *N* is enclosed in a chamber which has a lens *R* in a focusing mounting. It will be apparent that the latter arrangement closely resembles a camera, and it is set up so that the image of the disc *M* is focused on the disc *N*. Witnin the chamber there is a photo-electric cell *S*, which receives light reflected from the face of the disc *N*. When the disc *M* is stationary, a pulse-signal with a frequency of 50 cycles per sec. is generated by the cell *S*. As the surface *K* is traversed beneath the stylus of the comparator *L*, the disc *M* is rotated in the same direction as, or in the opposite direction to, the disc *N*, and the frequency of the signal from the cell S is increased or decreased. It should be noted that it is not always necessary to replace the pointer of the comparator by a complete disc. In many instances, a slotted sector will suffice. It is often possible, moreover, to employ a printed black and white member in place of the disc *M*. Provided that the dial of the comparator can be illuminated with sufficient brightness, it may even suffice to paint the dial black and the indicating pointer white.

The system shown in Fig. 9 can be employed either to record a tape to control the movements of a machine tool member in the manner already described, or to control a selsyn and fixed commutator motor whereby the machine member is operated directly. Since it is readily possible to obtain a response from a selsyn that is accurate within one-tenth of a revolution, and each revolution of the selsyn can be equivalent to a movement of the comparator stylus through 0·01 mm. (0·0004 in.), it will be apparent that the recording system has an accuracy of 0·001 mm. (0·00004 in.).

Experience has shown that when the power required to actuate a machine member is not excessive, a fixed commutator motor can follow a recorded motion with a maximum slip equivalent

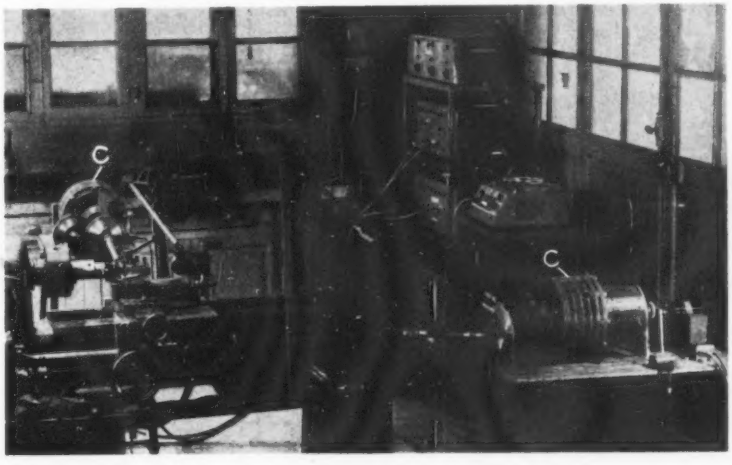


Fig. 7. The experimental set-up for operating a lathe by the C.R.S.I.M. system. Fixed commutator motors drive the lead screw and the cross-traverse screw through reduction gearing and universally-jointed shafts

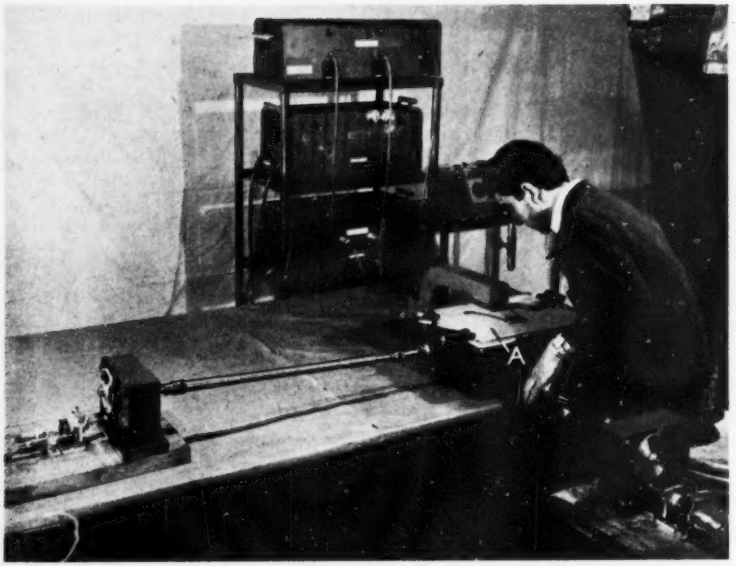


Fig. 8. An application of the C.R.S.I.M. system to copy milling. A drawing of the form to be produced is mounted on a table which is moved so that the outline is scanned by a microscope. The table movements are recorded on a magnetic tape which is employed to control a milling machine

to the spacing of the segments of the commutator. The motors built for the lathe set-up described have commutators with 47 segments and are connected to the machine traverse screws through reduction gearboxes which have an input/output ratio of 6:1. In consequence, the accuracy of operation is 1/282-revolution of the traverse screw. When the power required to operate the machine screw is large, it is necessary either to employ a more powerful fixed commutator motor, or to be satisfied with a lower standard of accuracy, since the slip in the motor is then greater than the spacing of the commutator segments.

The fixed commutator motors can be run at speeds up to 800 r.p.m., but for the different set-ups that have been tried out so far, control signals with frequencies varying between 25 and 75 cycles have been employed, and the corresponding maximum speed of the associated selsyn has been 1,500 r.p.m. The output shaft of the selsyn is coupled to the brush-carrying shaft of the motor through a 2:1 reduction gear, so that the output shaft of the motor rotates in either direction at a maximum speed of 750 r.p.m. Since the output shaft drives the traverse screw of the machine through a 6:1 reduction gear, the maximum speed of the screw is 2·08 rev. per sec.

This rate can be readily increased in one direction, to provide for a rapid return motion, since the selsyns employed can be run at high speeds. The speed cannot be correspondingly increased in the opposite direction, however, since it is desirable that the frequency of the control signals should not be reduced below 25- or at the very least 20-cycles per sec.

From Fig. 6 and 7, it may be noted that provisions are made for the easy disconnection of the fixed commutator motors from the lathe, to ensure that the movements of the operator are not restricted during the recording sequence. Such an arrangement is only necessary for the experimental set-up shown, and in a commercial application, the motors would be incorporated in the machine. The motors must be supplied with D.C. power, to ensure the necessary accuracy and freedom from oscillation, and, as has already been mentioned, each has a consumption of 10 amp. at 32 volts.

The power supply can be derived either from a motor-generator set or from an inexpensive selenium rectifier. If the equipment is required to operate to a high degree of accuracy, it is advantageous to connect all the fixed commutator motors in series with a metadyne to ensure that they are driven by a constant current supply.

The selsyns each consume 36 watts (18 watts for each rotor and stator), and this power can readily be obtained from standard electronic valves operating on a 400-volt supply, one valve being required for each phase and four valves for each rotor. For the equipment described, the valves are supplied with power from a rectifier of the type employed for radio work, but a small motor-generator set could be used. The total power

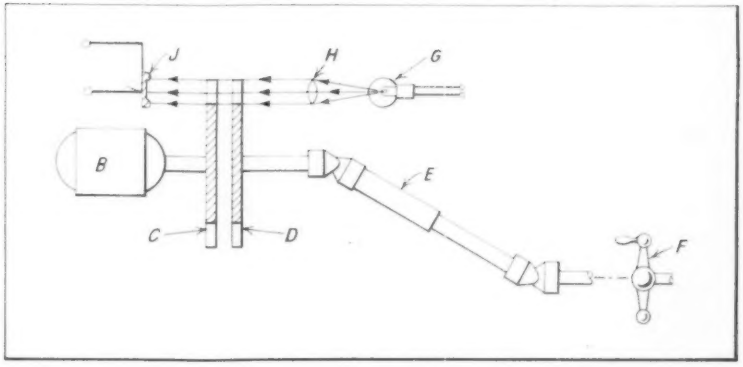


Fig. 9. Diagram showing how a stroboscopic vernier can be employed, in place of a selsyn, for the production of the signals to be recorded. This system is claimed to afford a higher degree of accuracy

required by the installation is of the order of 2·5 kW.

When the system is applied commercially to a machine tool (for example, a lathe), provision is made for engaging the auxiliary functions of the machine—such as speed changing, stopping and starting the spindle, and indexing tool-carrying turrets—by means of electro-magnetic clutches and solenoids. These latter units can be actuated by the operator by means of push-buttons on a control pedestal adjacent to the machine. The various functions are thus engaged and disengaged during the production of the first workpiece, and for each action a signal is recorded on the magnetic tape. If a tape-recorder of the automatic-playback type is used, a batch of parts can then be produced by repeatedly playing-back the tape, and the various motions and auxiliary functions of the machine will be engaged and disengaged in the required sequence.

It is claimed that the C.R.S.I.M. system can be applied to the automation of standard machine tools; permits considerable flexibility of control; can also be employed for the automation of complex machines, such as those employed for assembly, painting and metal forming operations; allows standard machine tools to be used for making cams, and similar parts with accurate curved profiles, which can then be applied to actuate automatic machines, thus facilitating the batch production of complex workpieces; and enables standard machine tools to be employed for copying operations, by means of the photo-electric control system.

This article is based on certain information originally published in *La Machine-outil Francaise*, to which grateful acknowledgment is made, and on further information supplied by Mr. V. Gavreau, Chief of the Electro-acoustical Laboratory, C.R.S.I.M.

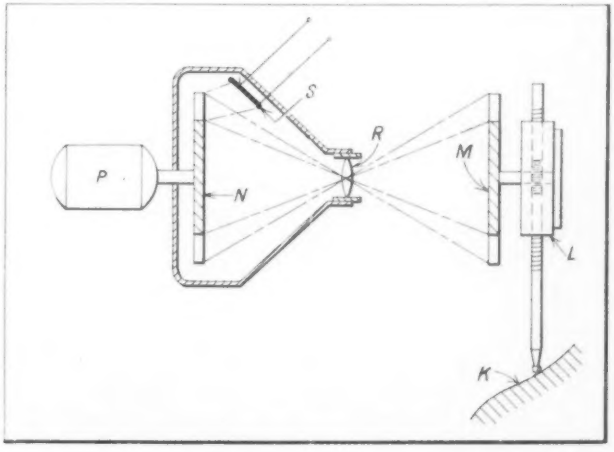


Fig. 10. An arrangement for generating signals to record a tape for profile milling is here shown diagrammatically. One disc of the stroboscopic vernier is mounted on the pointer spindle of a comparator, and its image, focused on to the other disc within a "camera-type" chamber, is reflected on to a photo-electric cell

New Manufacturing Techniques for Hydraulic Servo Valves*

By EDGAR M. HAKANSON†

Investigation showed that improved manufacturing techniques were required to provide balanced hydraulic servo valves of the necessary sensitivity and stability for critical applications and, if possible, at reduced cost.

The simple servo valve shown diagrammatically in Fig. 1 comprises two parts, namely, the sleeve *A* and the spool *B*. Such a valve may have to pass a stringent hydraulic flow test, and as requirements became more critical, and operating pressures are increased, the difficulties of manufacture are accentuated.

There are two general possibilities: (1) to manufacture each part to drawing tolerances so that all spools and all sleeves are interchangeable; and (2) to make each sleeve and spool as a matched pair.

Because so many elements enter into and affect flow test results, alternative No. 2 was selected as the most satisfactory for the majority of servo valves. In this connection, attention is drawn to the following major factors which affect hydraulic flow characteristics: (1) roundness and straightness of the sleeve bore; (2) correct alignment of the port edges in the sleeve; (3) roundness and straightness of the land surfaces on the spool; (4) surface finish of the spool lands and the sleeve bore; (5) diametral clearance between the spool lands and the sleeve bore; (6) sharpness of the corners of the ports and lands; and (7) the accuracy with which the dimensions of the spool lands and sleeve ports are matched to provide the specified positive or negative overlap.

Item (7) presents the greatest difficulty and it

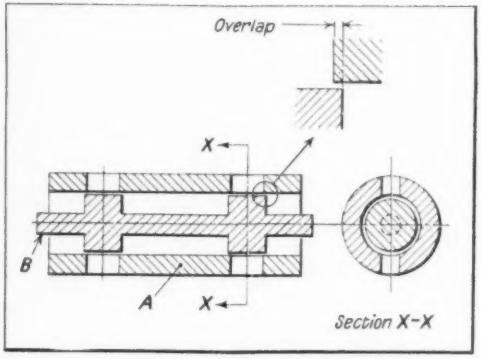


Fig. 1. Diagrams showing the spool and sleeve for a simple servo valve

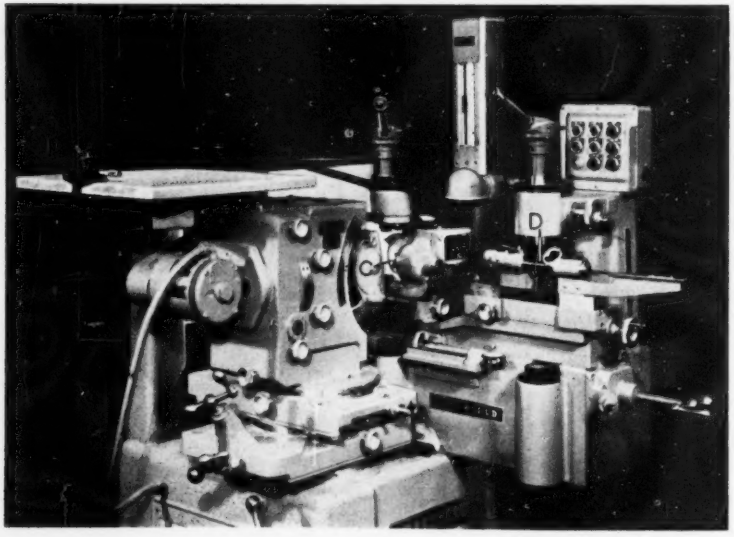


Fig. 2. A type 121-C Micro-Form machine arranged for match-grinding servo valve spools

* Abstract of a paper read before the American Society of Tool Engineers.

† The Sheffield Corporation, Dayton, Ohio, U.S.A.

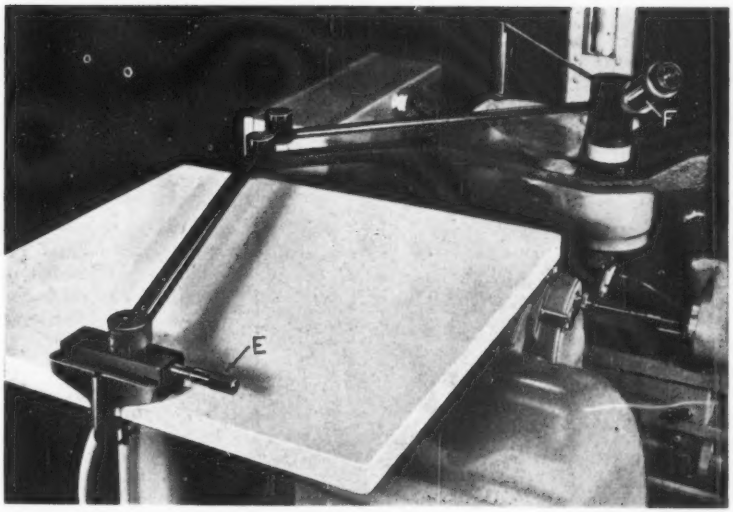


Fig. 3. The micrometer at *E* permits of fine adjustment of the microscope *F* for controlling overlap or "underlap"

was to overcome the associated problems that a new manufacturing technique was developed. In Fig. 2 is shown a type 121-C Micro-Form machine which is employed for match-grinding the spool to the sleeve, also for correcting the spool after a hydraulic flow test has been carried out.

The spool is mounted at the grinding station *C*, on the left, and the sleeve at the viewing station *D* on the right. Initially, the edge of one land on the spool is positioned under the cross-hairs of the microscope at station *C*, and the microscope is next set to provide for the amount of stock to be removed from the side face of the land, also for the positive or negative overlap specified. Adjustment of the microscope is effected by means of the micrometer *E*, Fig. 3, through a 50:1 ratio pantograph. With this arrangement, a micrometer movement of 0·001 in. changes the setting of the microscope *F* by 0·00002 in. It may be noted that, for the more critical valves, an overlap of the order of 0·0002 in. is required.

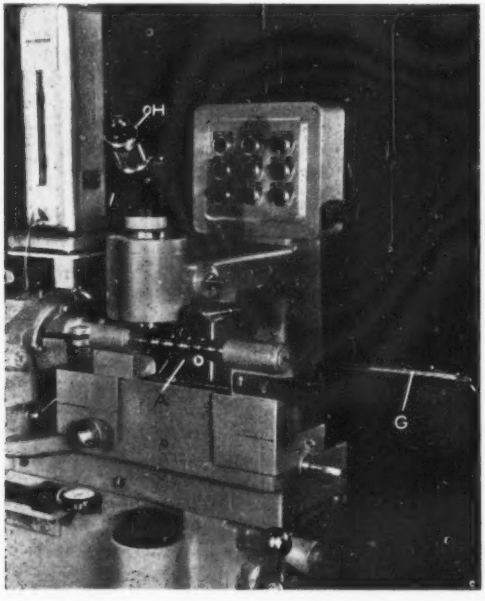


Fig. 4. A close-up view of the viewing station *D* with a sleeve in position

With the spool set in readiness for grinding, an auxiliary table at station *D* is adjusted until the corresponding port edge in the sleeve is aligned beneath the second microscope. The optical arrangement at this station is such that the edge of the port is viewed through the port in the opposite wall of the sleeve. To supplement good background illumination provided by a collimated light source, a very small bulb is passed through the tailstock into the bore of the sleeve to provide effective lighting of the port edge. This internal illumination unit is seen at *G* in Fig. 4, where the sleeve is indicated at *A* and the microscope at *H*.

In producing the sleeve, it is difficult to ensure that the two ports at one position are exactly opposite to one another in the sleeve bore. With the set-up shown in Fig. 4, the sleeve can be turned and observations can be made to determine which port edge will first be exposed by the edge of the spool land. The sleeve can then be set with this edge aligned with the microscope, or in the mean position if desired. While this setting is being made, an opportunity is also afforded of inspecting the quality and sharpness of the port edges. Once the sleeve

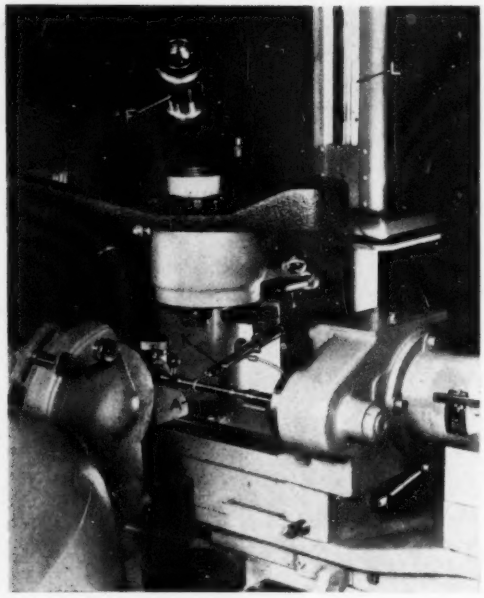


Fig. 5. A close-up view of the grinding station showing the indicator and air gauge employed for the final correction stage

has been positioned, the auxiliary table is locked to ensure that the relationship of the sleeve and spool remains constant throughout the series of grinding operations.

With the aid of the microscope at the station *C*, Fig. 2, the operator now grinds the face of the spool land to bring the edge into the correct relationship with that of the sleeve port within ± 0·00015 in. The operation can be performed with confidence because it is possible clearly to observe the position of the wheel in relation to the microscope cross-hairs. When this stage has been completed, the main table is re-set to bring the opposite edge of the port in the sleeve into alignment with the microscope *H*, Fig. 4, and the opposite face of the spool land is similarly ground. The operation is then repeated for the second pair of ports and land.

The servo valve is next hydraulically flow-tested as a unit, and, depending on the results, a chart is drawn up to indicate the amount of stock that must be removed from each land face on the spool in order to obtain correct matching or balance. With this information available, the spool is returned to the machine and mounted at the grinding station *C*. As a rule, the correction of a spool involves removing material in amounts ranging from as little as 0·000025 in. to as much as 0·0003 to 0·0004 in. To enable this operation to be performed accurately, provision is made for continuous indication of progress, as may be seen in Fig. 5. At a point opposite the grinding wheel, a sensitive Airetest indicator *K* is brought into contact with the land face at a specified distance below the edge. This Airetest indicator is connected to a 5,000:1 or 10,000:1 column-type air gauge *L*. While grinding is in progress, the amount of material removed is indicated directly by the float of the air gauge. In this way it is possible to remove material to an accuracy of ± 0·00001 in.

With previous methods of producing servo valves of this type it was necessary to carry out flow testing and correction of the spool as many as eight, ten or even twelve times. There is no need to emphasize the time and expense involved with this procedure or the loss that would be incurred if the operator, when correcting the spool for the twelfth time, scrapped the part. With the new method, depending on the specification, match ground valves will often pass the flow test without requiring any correction. For critical valves, however, one correction is usually necessary, and sometimes a second, to obtain the required degree of hydraulic balance in the assembled valve.

PRODUCTION OF MOPEDS AND MOTOR SCOOTERS—During July and August of this year the production of mopeds and motor scooters reached totals of 3,000 and 5,320, respectively. The totals for the corresponding periods in the previous year were 2,980 and 5,670.

NEW METHOD OF MARKING DESIGNS ON METAL SURFACES—Trade marks, identification numbers, and similar markings can be made on the surfaces of tools, for example, by means of a new stencil process which has been developed by the Ellams Duplicator Co., Ltd., 5 Dean Street, London, W.1. To prepare the stencil, a black and white drawing is made of the design required, and an electronic stencil cutter is then employed. A light source scans the drawing, and, by means of a photo-electric cell, electrical impulses are generated which perforate the stencil material in the areas corresponding to the black portions of the original design. The stencil is placed on the metal surface and the part is subjected to an electro-chemical etching process. Of a non-conducting and electrolyte resisting material, the stencil ensures that only the metal below the perforated areas is etched.

Special Semi-automatic Vapour Blasting Machine for Small Drilled Parts

The special machine illustrated in Fig. 1 has recently been built by British Vapour Blast, Ltd., Rose Hill, Coalbrookdale, near Ironbridge, Shropshire, for the semi-automatic vapour blasting of small metal components. Each component has a central bore of small diameter, with which from two to five $\frac{1}{16}$-in. diameter holes communicate, and the machine is designed to remove the internal burrs thrown up during the drilling operations, also to clean out any swarf left at the machining stage. The equipment is 6-ft. square in plan, by 8 ft. high, and, as may be seen from Fig. 1, is entirely encased in sheet metal panels which are removable to facilitate serving and adjustment. Components to be treated are loaded through a sliding door at the front (right-hand side) of the machine and are subsequently discharged down the chute at the left, into a container.

In Fig. 2, the unit is seen from the same position as in Fig. 1, but with the panels removed to show the internal arrangements. The components to be treated are loaded through the door, which is automatically opened, as empty finger-jigs are moved into position in front of it, by a cam and link mechanism. A skeleton turntable of fabricated construction, of approximately 4 ft. diameter, incorporates six arms, each of which carries four finger-jigs into which the components are loaded. This table is indexed by a Geneva mechanism and is located at the various settings by pneumatically-operated rollers which ensure accuracy of positioning of the jigs to within $\pm \frac{1}{64}$ in.

From the loading position, the components are carried to a station at which they are washed with a high-pressure spray of detergent to remove any grease or cutting lubricant. Next, they pass to three successive blasting stations equipped with guns having ceramic nozzles which are arranged at various angles to treat the different holes.

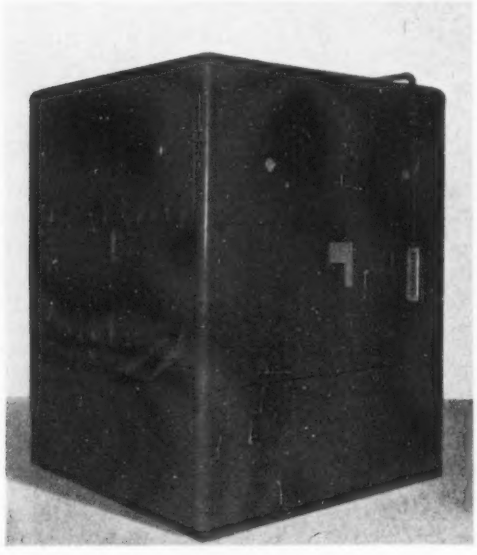


Fig. 1. This special semi-automatic vapour blasting machine has been designed for the removal of internal burrs thrown up during drilling operations on small metal components

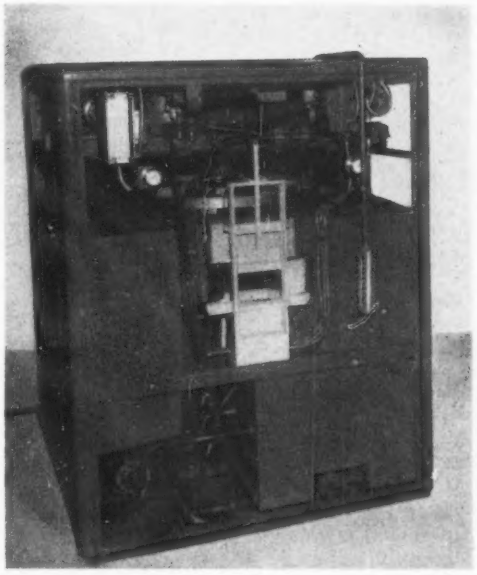


Fig. 2. In this view, with the sheet metal panels removed, some details of the construction of the vapour blasting machine may be observed

Finally, they are transferred to the last station where they pass under a water spray which washes away any remaining abrasive. At this station, the parts are ejected from the finger jigs and emerge down the discharge chute, leaving the finger jigs in the water stream so that any abrasive matter or dirt is flushed away. The detergent solution and the water for final washing are supplied by separate motor-driven pumps.

Abrasive and water mixture is pumped to the blasting guns at a pressure of 150 lb. per sq. in. by means of a 2-stage Vacugland pumping unit installed in the cabinet base. All bearings in the machine are supplied by a one-shot centralized lubrication system. The pendant carries switches for starting or stopping the indexing motion, the main, detergent and water pump motors, and an exhaust fan for the removal of water vapour.

Ruston Gas-bearing Circulator

Ruston & Hornsby, Ltd., Lincoln, have introduced the NFB gas-bearing circulator, shown in Fig. 1, which has been developed by their nuclear division, and it is intended for use where it is necessary to circulate gas at high temperatures and pressures, with minimum leakage, as is frequently required in the nuclear field. To avoid the need for oil bearings, the rotating assembly of the circulator, shown in Fig. 2, is carried on bearings in which the pumped gas, which may be air, carbon dioxide or helium, is used as a fluid. The production of the bearing portions calls for exceptionally high standards of machining, the shaft diameter being held to the specified size within 50 micro-inches over a 5½-in. length. All the moving parts are contained within a sealed pressure vessel, and the electrical leads are brought out through vacuum-tight seals.

The capacity of the class NFB circulator was determined after an investigation of the probable requirements of a number of potential users, both in the United Kingdom and abroad. In its present form, the unit is capable of satisfying current demands in connection with laboratory experiments and will circulate air, carbon dioxide or helium under all conditions up to 450 lb. per sq. in. abs. and 450 deg. C.

The unit will operate over a speed range of 10 to 1 when connected to a variable-frequency a.c. supply. In addition, the unit will provide for many of the pumping requirements for the auxiliary circuits associated with large gas-cooled reactors.

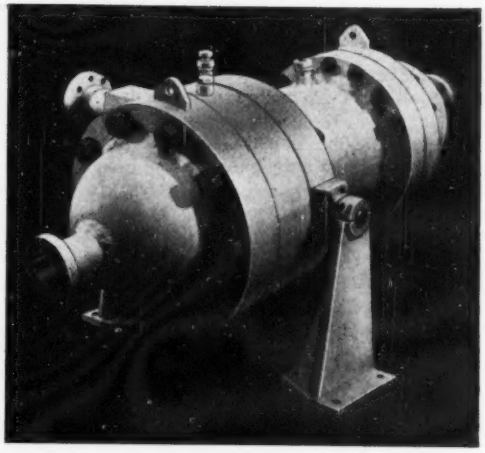


Fig. 1. Ruston class NFB gas-bearing circulator for handling air, carbon dioxide, or helium at 450 lb. per sq. in. pressure for nuclear purposes

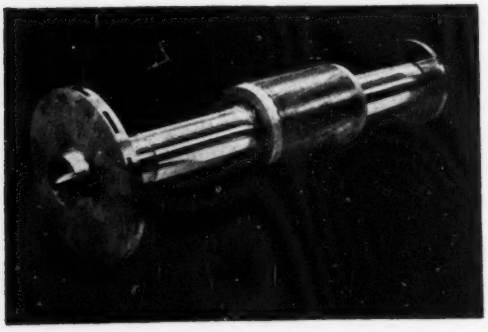


Fig. 2. The rotating assembly of the Ruston gas-bearing circulator

At the company's research centre, the circulator is now being used for experiments associated with the design and development of nuclear power stations of 5- to 25-MW. output. The overall dimensions of the unit are 4 ft. 9 in. long, 2 ft. 3 in. wide and 2 ft. 3 in. high.

Teddington Automatic Air-gauging Equipment

Reference has already been made in MACHINERY, 93/364—13/8/58, to the range of air-gauging equipment introduced recently by Teddington Industrial Equipment, Ltd., Sunbury-on-Thames, Middlesex. One of the latest additions to this range is the type 88 pneumatic size control unit shown in Fig. 1, which, in conjunction with various alternative gauging heads, is designed for a automatic dimensional control of work on machine tools. It can be employed in connection with such processes as grinding and light turning, and all pneumatic and electrical equipment, other than that directly associated with the gauging head, is housed within the unit illustrated.

This equipment includes a set of pneumatic/electric relays of a new, improved design, which are operated by signals from the gauging head. Sensitivity of these relays is such that, at the maximum amplification of 5,000 ×, they are capable of a discrimination of less than 0·000005 in. The pneumatic/electric relays, in turn, actuate electric output relays, which control the various machine functions, also, where appropriate, signal lamps. Either two or four output relays are provided, and the rating of the contacts is 3-amp., 250-volt, A.C. The relays are fully adjustable, and each can be set to operate at any point in the measuring range. Consequently, the equipment is readily adaptable to a wide variety of work, processes, and machines, and it can be arranged to operate in a number of different ways.

The equipment may be employed either for "in process" or "post process" gauging, and typical examples of functions of a grinding machine that can be controlled "in process" include rapid in-feed, slow in-feed, dwell, rapid withdrawal, and wheel dressing. "Post process" gauging may be employed for through-feed centreless grinding, for example, on a "trend" basis, and incipient errors are then detected and corrected before rejects are produced. Referring to Fig. 1, it will be observed that three signal lamps are provided. These lamps are green, amber and red, and at a representative set-up for working on a "trend" basis, the following indications are obtained.

So long as the components are within a predetermined tolerance—usually half that permitted—the green lamp is illuminated, to indicate "accept." If the half-tolerance is exceeded, the amber light is displayed, and a corrective signal is fed to the machine. Should the machine, through some fault, fail to respond, the red lamp is illuminated. Although there are only three lamps, a greater number of indications can be provided by using some of them twice. With this object, they are arranged to operate in sequence, with the relays, in the following order. Red, amber, green, amber, red.

Typically, such a sequence would be employed for an "in process" set-up, for example, for grinding a component between centres, with red denoting rapid in-feed, amber, slow in-feed, and green, the period of dwell before rapid withdrawal. In the event of incorrect functioning, such as failure of the head to withdraw, the amber lamp would again be illuminated, and a corrective or precautionary signal would be fed to the machine. Should the latter still fail to respond, the red lamp would be illuminated, and an emergency shut-down signal would be transmitted. By setting the final relay to operate on the low limit of the work, it can be ensured that, in such an event, an out-of-tolerance component is not produced.

Referring again to Fig. 1, it will be observed that the control unit also incorporates a standard 6-in. dial-type indicating instrument, equipped

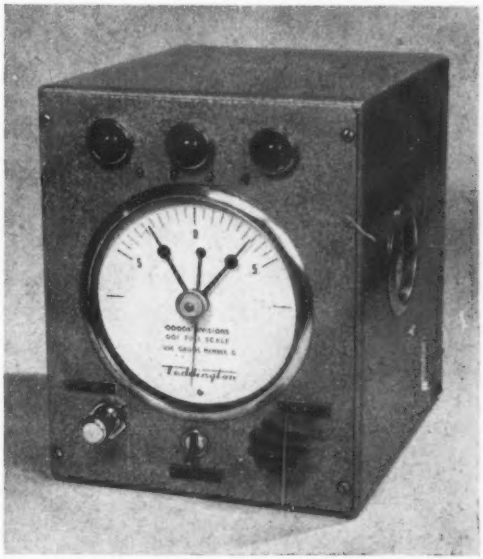


Fig. 1. Teddington type 88 pneumatic size control unit, incorporating coloured indicator lights

H

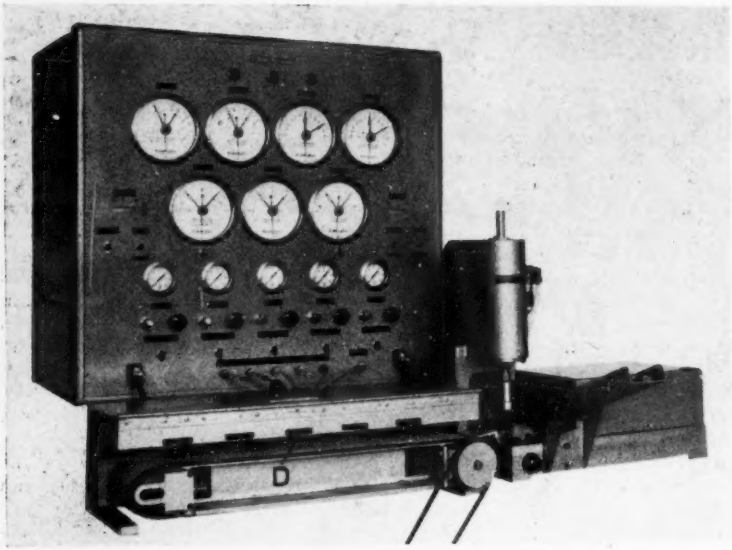


Fig. 2. Automatic equipment for checking taper roller bearing outer races on seven dimensions simultaneously, and segregating them into six categories

with adjustable tolerance pointers. The particular example shown has a scale that covers a range of 0·001 in., and is direct reading to 0·00005 in. This range corresponds to the maximum amplification mentioned, and the amplification is adjustable for any range from 0·001 to 0·004 in., for which readily-interchangeable scales are available. For special applications, lower amplifications can be provided.

Three standard types of gauging heads are available, all of which are adjustable to accommodate a wide range of work size. An external caliper type, designed for mounting on the wheel guard, is normally employed for grinding between centres, and an overall size-range of ½ in. to 6 in. diameter is covered by a series of interchangeable jaws. A typical "post process" gauging head of the design employed for through-feed centreless grinding was described in the earlier article, to which reference has been made. Where the parts leave the machine in a continuous flow, an adjustable "trend" head is employed, and this type is available in two sizes, covering ½ in. to 1½ in. diameter, and 1½ in. to 3 in. diameter.

"Timed" gauging heads of caliper type are employed for parts that leave the machine at intervals, or are interrupted by flats or grooves, and are adjustable from ½ in. diameter to 3 in. diameter. In units of this type, the gauging impulse is triggered either by a micro-switch or an air jet, so that a selected portion of the work is measured. All type 88 control units are equipped for operation in this manner. Special-purpose gauging heads, designed to suit individual machines, can be provided for plunge-feed centreless grinding and internal grinding. The equipment described can be operated on a clean, dry air-supply at any pressure from 50 to 150 lb. per sq. in., which need not be regulated.

AUTOMATIC GRADING EQUIPMENT FOR TAPER ROLLER BEARING RACES

The company has recently supplied to a well-known specialist firm of roller bearing manufacturers, the fully-automatic gauging and sorting equipment shown in Fig. 2, which is stated to be the first of its kind to be installed in this country.

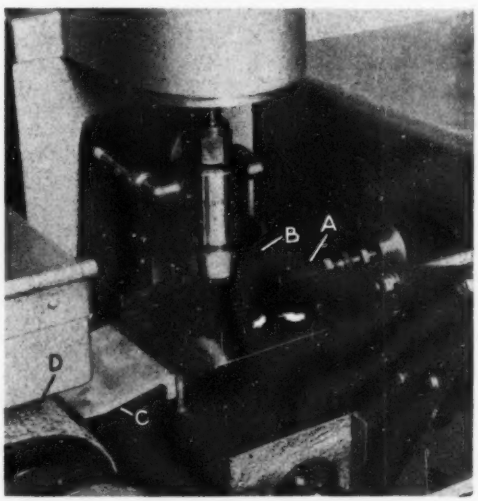


Fig. 3. Close-up view of the gauging heads and feed equipment of the machine seen in Fig. 2

This equipment is designed to perform seven checks simultaneously on taper roller bearing outer races, and to segregate the components into six categories. Interchangeable gauging heads are employed, to enable components of various sizes to be accommodated, and direct jets are used throughout, to minimize errors due to wear. A close-up view of the gauging heads and associated feed equipment is given in Fig. 3.

The races are placed, all the same way up, in the inclined feed magazine seen at the right, and each, in turn, is advanced to the gauging position by the air-operated pusher *A*. Here, the work is located between blocks that incorporate jets for measuring the upper and lower external diameters, taper, and the width, and a vertical pneumatic ram lowers the conical gauging plug *B* into the bore. This plug is provided with two pairs of jets, for checking the upper and lower internal diameters, and taper. The entire cycle, it may be noted, is timed by a sequence controller, and at this stage, the various gauging circuits are energized, including the seven corresponding indicating instruments seen on the main cabinet in Fig. 2. According to the dimensions of the work, relays are operated, which pre-set an appropriate deflector of the segregating equipment.

Once the gauging impulse has been delivered, and the segregating deflector is set, the plug *B* is raised, and the pusher *A* is withdrawn, and again advanced. A fresh component is thereby moved into the gauging position, and pushes the gauged component on to the short inclined ramp *C*, Fig. 3. This ramp guides the component on to a small belt conveyor *D*, Fig. 2 and 3, from which it is diverted sideways by the deflector. There are five deflectors at intervals along the belt, which correspond to the following categories. "Scrap"; three grades of salvage rejects, comprising "reject 1," "reject 2" and "reject 3"; and "second quality accept." For all components within "first quality" tolerances on all dimensions, the deflectors remain raised, so that these components are delivered from the end of the conveyor. The equipment is required to check and grade 600 races an hour, but can operate at more than twice that speed.

Newgar Automatic Assembly Machine for Tags

Shown in Fig. 1 is the latest Newgar machine built by Newman & Guardia, Ltd., South Road, Temple Fields, Harlow, Essex, for automatically assembling metal tags in electrical components, such as valve bases and turret tuner panels for television receivers, for example.

Operated entirely by compressed air, the machine has a working speed of 80 cycles per min., and is shown set up for assembling, simultaneously, six tags in line, in a panel for a turret tuner, at each cycle. Alternatively, the machine can be supplied for handling turret tuner panels with four tags, or for assembling as many as eight tags into slots disposed on a circle.

Interchangeable tables incorporating 12 or 24 work holding fixtures can be provided, and for the indexing movements, a British Bellows (Benton & Stone, Ltd.) air-operated unit is mounted on the base. The tag material is supplied by the company in 200-ft. long, pre-formed, strips, which are fed to the assembly head from a pair of reels. A portion of the strip, indicating the shape of the tags, is shown in Fig. 2.

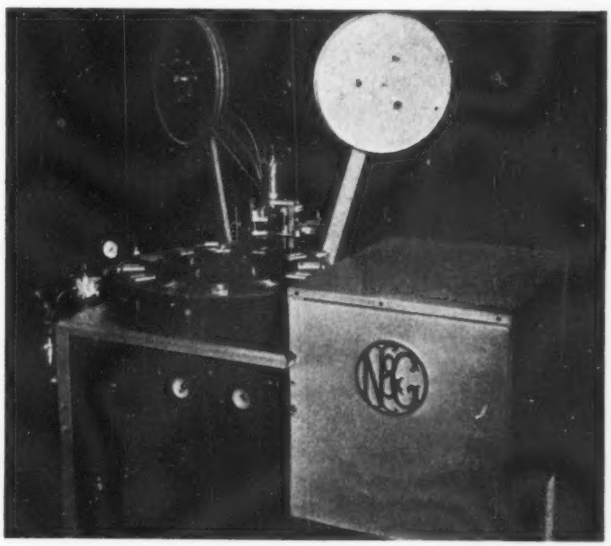


Fig. 1. Newman & Guardia machine set up for assembling tags in turret tuner panels

Referring to the close-up view, Fig. 3, the assembly head incorporates a pair of slides, as indicated at *A* and *B*, which are mounted above the table and can move vertically on a pair of cylindrical guide bars. Carried on the same guide bars, but below the table, there is a third slide which is arranged to perform a bending operation on the tags, as will later be explained. The tag material is passed through guide slots in the slide *A*, and is held in other guide slots in the slide *B* throughout the entire working cycle of the machine.

At the completion of an indexing movement of the table, which brings a fresh workpiece into position beneath the assembly head, a signal is transmitted to a solenoid-operated air valve. As a result, the slide *A*, and the slide beneath the table, are moved towards each other by the action of separate air cylinders. At the same time, the slide *B*, which is suspended from the slide *A* by a flange at the upper end of the guide pillar *C*, moves downwards freely under gravity, with the slide *A*, until it makes contact with the top surface of the work-holding fixture.

During the continued downward movement of the slide *A* under the action of the air cylinder, built-in spring-loaded jaws, which engage with the top edges of the ears of the form indicated at *X* in Fig. 2, cause the lowest tags to be pushed through slots in the workpiece. Two small lugs on the lowest tag on each strip, now extend beyond the bottom surface of the workpiece, and these lugs are bent through 90 deg. by a forming tool which is mounted on the third slide, and is moved towards the centre of the table by another air cylinder. Simultaneously, a cropping tool built into the slide *B* (Fig. 3) is operated by a fourth air cylinder to cut the lowest tags from the strips.

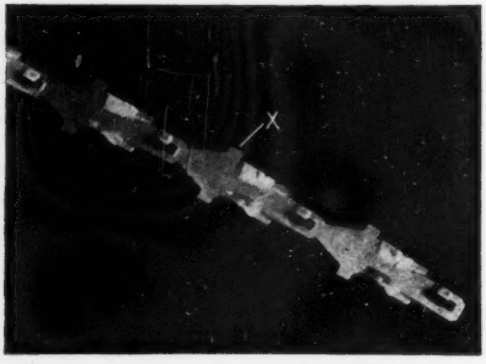


Fig. 2. A portion of the pre-formed strip from which the tags are inserted in the work and then cut on the machine shown in Fig. 1

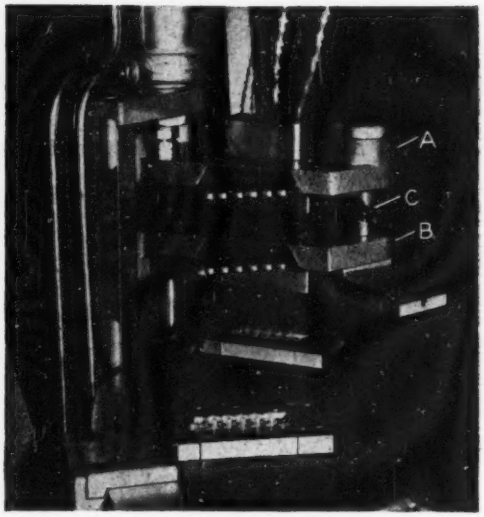


Fig. 3. Close-up view showing part of the assembly head and some of the work-holding fixtures on the indexing table

The tags are now secured by the lower edges of the ears and by the lugs, which engage the top and bottom surfaces of the workpiece respectively.

Next, the slides *A* and *B* are raised, and the slide beneath the table is moved downwards by the air cylinders, to complete the working cycle. The slide *B* also incorporates spring-loaded claws, which engage with the top edges of ears on the strips, to prevent the latter from being withdrawn from the guide slots while the slide *A* is being raised, independently, through a short distance at the beginning of the return stroke. During this independent upward travel, the claws in the slide *A* are opened, and then closed by spring action, so that they engage with other ears on the tag material in readiness for the strip feeding operation during the next working cycle.

POLYTHENE LETTERS FOR PATTERNS.—Aldridge Plastics, Ltd., 155 Charing Cross Road, London, W.C.2, are producing a range of polythene letters for use on foundry patterns. These letters are pliable and it is stated that they can be moulded to any normal contour without difficulty, and secured with glue or pins. They are inexpensive, and owing to resiliency, it is claimed, do not become damaged or burred as a result of ramming. Owing to the self-lubricating properties of polythene, moreover, there is no tendency for sticking to occur.

Vertical Hot-spinning Lathe for Titanium

A new method of producing high strength spherical pressure vessels in titanium and other metals is now being employed by Titanium Fabricators, Inc., Burbank, California, U.S.A. Developed to permit fabrication of pressure vessels of comparable strength to those made from stainless steel, but of only 40 per cent the weight, the new method involves the use of a special vertical spinning lathe, as shown in Fig. 1. This machine has a circular table which can be driven at variable speeds and carries a hemispherical steel former, of a size corresponding to the internal dimension of the half shells from which the pressure vessel is to be assembled by welding. A framework provides pivots on each side for the support of a yoke, of fabricated construction, which can be moved in an arc over the table.

The yoke carries a large hydraulic cylinder, and attached to the ram of this cylinder is a hardened roller whereby pressure is applied to the blank to be formed. Forces up to 24,000 lb. can be exerted by this cylinder, the force selected depending on the thickness of the material, and whether or not it is heated. Movements of the yoke are imparted hydraulically, and it can be traversed above the former at any desired speed. By using a suitable former, paraboloids can also be produced, and the material can be thinned at any desired positions by varying the loading of the roll. Circular blanks with central holes can conveniently be attached to the former by means of a

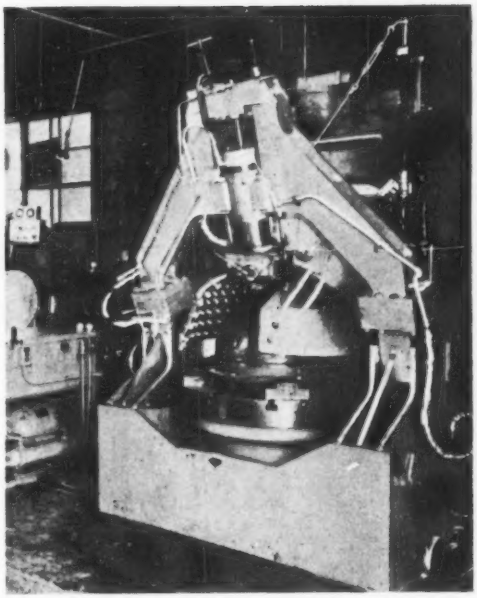


Fig. 1. Hydraulically-operated hot-spinning machine constructed by Titanium Fabricators, Inc., for the production of hemispheres from titanium blanks

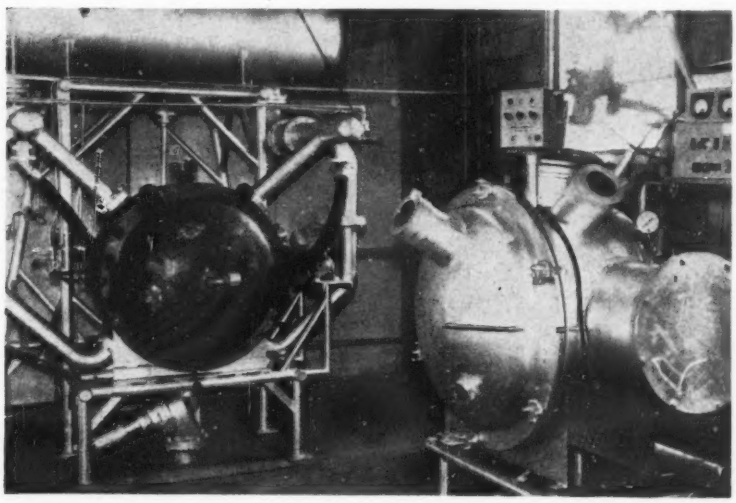


Fig. 2. A pressure vessel is produced by welding two hemispheres together, in the chamber on the right, in an inert gas atmosphere. Heat treatment, including water-quenching, is then carried out in the second chamber, under vacuum

central bolt or stud, and several passes may be necessary, especially on such materials as magnesium or titanium which must be formed slowly because of their metallurgical structures.

Special equipment is provided for heating the blanks initially, and while forming is in progress, and a gas-heated muffle of suitable shape is seen in position on the machine in Fig. 1. After the completion of the spinning operation it is usually necessary to machine the edge of the hemisphere true, and to provide a chamfer in preparation for welding. For this purpose, a cutter holder is mounted on the side of the machine. Welding is carried out in a special unit, seen at the right in Fig. 2, in which the two hemispheres are mounted in a fixture with their edges accurately aligned. An inert gas is then pumped into the chamber to replace the air, and welding is performed semi-automatically, under the control of an operator who observes the work through one of the windows.

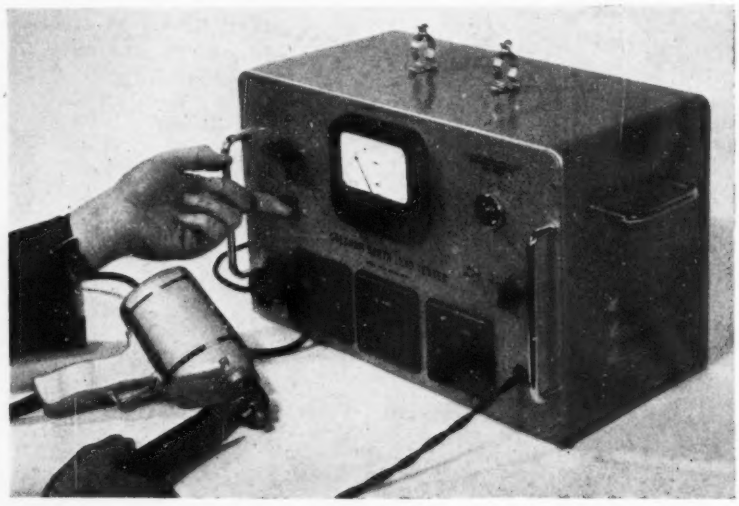
The pressure vessels are next heat-treated in another special chamber, seen at the left in Fig. 2, in which it is inserted at room temperature. A pump is then employed to exhaust the chamber, and after the sphere has been heated, high pressure jets are turned on to quench the surface simultaneously all over. This method avoids risk of formation of steam pockets or bubbles on the surface, which might result in distortion. In addition to the production of spheres of the type described, it is envisaged that with a machine of slightly different design, conical or cylindrical shapes could be obtained. In addition, it should be possible to form cylinders which are designed with hemispherical ends.

Gresham Earth Lead Tester

The instrument here shown has been developed by Gresham Transformers, Ltd., Hanworth, Middlesex, for testing the continuity and adequacy of the earth leads of portable tools and other appliances. An appliance is plugged-in to one of the three sockets provided on the front face of the instrument, these sockets being of the standard 3-pin type, rated at 5-, 13-, and 15-amp. Contact with the casing of the appliance is made by means of the 2-pin probe seen in use in the left foreground.

A test is carried out in four distinct stages, as follows: (1) the resistance of the appliance lead is measured and noted; (2) a current of 100 amp. is passed through the lead for a period of 2 sec.; (3) the resistance of the lead is again measured; and (4) mains voltage is applied to the tool for a running test. If the earthing characteristics of the lead are satisfactory, the resistance readings recorded at tests (1) and (3) will be identical. On the other hand, if the resistance at stage (3) is greater than at (1), the lead is defective and requires further examination. If there is an open circuit existing in the tool, the resistance recorded at test (3) will be infinite.

This instrument, which is designed for operation on a 240-volt, 50-cycle, single-phase current supply, has been developed by the company in close co-operation with H.M. Inspectors of Factories, and has been subjected to official tests and field trials.



Gresham Earth Lead Tester for Portable Tools and Similar Appliances

Calculations of Eccentric Clamp Dimensions

By KURT HEBER, West Berlin

Eccentrics are commonly used for clamping purposes in jigs and fixtures. They are easy to produce and, if correctly made, ensure that the worm is rigidly held.

The tolerance on the work dimension between the locating surface and the clamping surface determines the length of stroke S necessary for proper clamping. The length of stroke of an eccentric clamp, in turn, depends on the eccentricity E of the clamping surface and its position angle. In any application, however, proper clamping is obtained when the eccentric is self-locking. It can be assumed that a self-locking action will be obtained if the angle of friction α between the workpiece and the eccentric clamp is equal to or less than 5 deg. 43 min. Substituting this value in the equation $E = D/2 \sin \alpha$ (where D is the diameter of the eccentric) gives the relationship $D > 20\ E$ for a self-locking clamp.

The diameter of the eccentric depends on the dimensions and the design of the jig, but should be made as large as possible because of the improved wear-resistance obtained with a larger contact area. Position angles are limited by the operating range. It is important for the designer to have a clear conception of these factors in order to determine the correct dimensions of an eccentric clamp. To obtain these dimensions by applying trial-and-error methods is a waste of time.

When the centre of the eccentric is rotated through 180 deg. about the centre of the shaft, the length of stroke is $2E$. In the middle position, after rotating through 90 deg., the length of stroke is equal to the eccentricity E. However, the length of stroke does not increase uniformly for each increment of angle during the rotation from 0 to 180 deg. The curve of the rate of stroke increase is harmonic, and rises slowly up to a position angle of 60 deg. Then the rate of increase is approximately constant up to a position angle of 120 deg. From this angle to the 180-deg. position angle the curve becomes flatter and levels off. Only in the range from 60 to 120 deg. does the eccentric rise fairly uniformly for each increment of rotation. Thus, for the best results, the clamping range should be restricted to within -30 to $+30$ deg. of the middle position. The relation between clamping range angle B and the eccentricity E for a fixed length of stroke S is indicated in the accompanying diagrams, which show the eccentric clamp at the two limiting angles.

The vertical distance between the centre of the eccentric and the horizontal line through the centre of the shaft is equal to S', or one-half the length of stroke S, and the angles are $\pm B/2$ from the middle position.

$$\therefore \sin B/2 = S'/E$$

$$\text{and as } S = 2S'$$

$$\sin B/2 = S/2E.$$

Example:

Given: $S = 0{\cdot}020$ in., $D = 1{\cdot}600$ in., $E = 0{\cdot}080$ in.

To find B

$$\sin B/2 = S/2E = 0{\cdot}125$$

$$\therefore B = 14 \text{ deg. } 22 \text{ min.}$$

As this clamping range angle is very small, B is chosen as 30 deg., and the eccentricity and the diameter become smaller.

$$E = S/(2 \times \sin B/2)$$

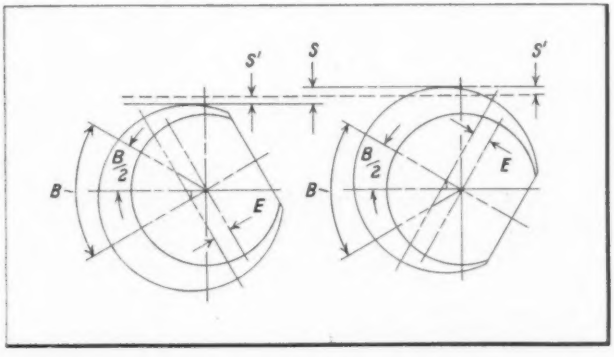
$$= 0{\cdot}020/(2 \times 0{\cdot}258) = 0{\cdot}039 \text{ in.}$$

$$D = 20\ E = 20 \times 0{\cdot}020 = 0{\cdot}780 \text{ in.}$$

If the whole range of 60 deg. were to be used, there would be an eccentricity of

$$E = 0{\cdot}020/(2 \times 0{\cdot}5) = 0{\cdot}020 \text{ in.}$$

In this way it is simple to obtain the most effective dimensions for clamping range angle, eccentricity, and length of stroke for any eccentric clamp.



The range angle B of an eccentric clamp should not exceed 60 deg. symmetrically disposed about the mid-position

"Gun" Drilling with Portable Power Tools

In MACHINERY, 89/170—20/7/56, reference was made to special cutting tools which have been developed by the National Twist Drill & Tool Co., U.S.A., to facilitate the production of accurate holes. The tools include gun drills of the centre-cut (conventional) type and of the target (trepanning) type, and various examples of the use of each design were given. Production of accurate, well-aligned holes often presents considerable difficulties, particularly when the components or assemblies to be drilled are too large or too awkward in shape for the operations to be carried out on a conventional machine tool. Such workpieces are usually drilled with portable equipment, and the National Twist Drill & Tool Co. and the A. B. Quackenbush Co., Glendale, Cal., U.S.A., have jointly developed portable tooling arrangements whereby holes can be produced with target-type gun drills, with a high standard of finish, and to close tolerances for position and alignment.

The equipment is seen in use in Fig. 1, for drilling a hole in an aircraft undercarriage assembly, and it comprises a Quackenbush portable power drill, and a special extension unit whereby the target-type gun drill is guided. Of a light-weight, high-torque design, the power tool is arranged to provide a positive mechanical feed for the quill. The only additional equipment that is necessary is a simple jig plate with bushed holes to receive the guide bushing that forms an integral part of the special extension unit. This jig plate can be either clamped to the work, or rigidly positioned in the correct relationship to it.

A typical arrangement of the extension unit, jig plate and workpiece is shown in Fig. 2. The end of the power tool body is indicated at *A*, and the extension *B* is screwed to it. A target-type gun drill *C* is held in the driving sleeve or chuck fitted to the tool spindle, and passes through a guide bushing *D* at the end of the extension unit. This bushing has two semi-circular recesses and arcuate slots which are engaged with the shoulder-screws *E*, to secure the extension to the jig plate *F*, and the reduced diameter portion is a sliding fit in the bush of the jig plate.

The driving sleeve or chuck of the power tool is surrounded by a special liquid-tight coupling *G*, which is held stationary by the connection *H* for the coolant supply. This connection passes through one of two slots *J* in the wall of the extension unit. Needle rollers are interposed between the tubular body of the coupling and the driving sleeve, in order that the latter member may rotate freely, and O-rings are fitted to seal the various members. Annular and radial passages are provided in the sleeve and the drill to

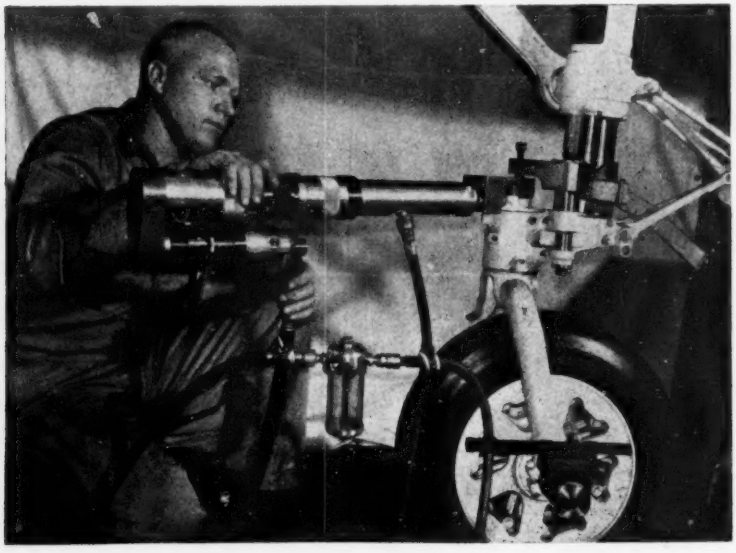


Fig. 1. Portable equipment for the production of holes with target-type gun drills, which has been developed by the National Twist Drill & Tool Co., and the Quackenbush Co., U.S.A., is here being used for drilling a hole in an aircraft undercarriage

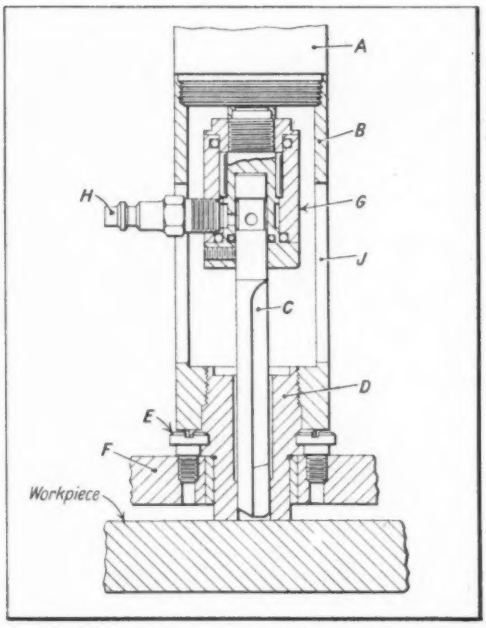


Fig. 2. Sectional view of a typical extension for a Quackenbush power tool, showing the guide bush for the target-type gun drill and the coolant-supply arrangements

allow the coolant to pass to the axial delivery holes in the tool, and thence to the cutting zone. The slots *J* in the wall of the extension unit provide for the escape of the swarf which is forced by the coolant out of the hole that is being drilled and up the groove in the gun drill.

Repositioning of the complete power tool assembly is readily effected, since it is only necessary to turn the tool through a small angle, to release the bush at the end of the extension from the shoulder screws of the jig plate, transfer the tool assembly to the next drilling position, and engage it with another pair of shoulder screws. It is important that the end of the drill guide bush *D* should abut the work-surface.

The power feed arrangements of the Quackenbush tool have been found to offer particular advantages when drilling operations are performed on work-hardening materials, such as stainless steels, high-strength steels and high-temperature alloys. Drilling feeds can also be readily adjusted, in small increments, to suit the drill diameter and the chip-forming characteristics of the work-material.

Compressed air, liquid or mist cooling may be employed. Compressed air has been found satisfactory for some of the softer materials, but for harder workpieces mist cooling is recommended. Either cutting oil or water-soluble compounds may be used in the mist unit connected to the shop air supply, and a typical arrangement is shown in Fig. 3. Water-soluble compounds have been found satisfactory in practice, and are cleaner to use.

Target-type gun drills can be tipped with various grades of tungsten carbide, and alloys with hardness values as high as Rockwell 50 C have been drilled with good results. Among the applications of these drills, with the portable equipment, may be mentioned the production of holes in a "sandwich" material, comprising a layer of aluminium alloy, a layer of stainless steel of Rockwell 47 C hardness, and two further layers of aluminium alloy. The holes produced were ⅝ in. diameter by 2½ in. deep. In another instance, holes were produced in multiple layers of aluminium alloy sheet.

Holes have also been gun-drilled in laminations of ordinary and pre-stretched clear plastics, used for windows in modern aircraft. When normal twist drills were employed to produce the holes, crazing lines, indicative of stresses or fractures, were formed around the holes, but accurate holes without crazing were obtained with the portable gun-drilling equipment.

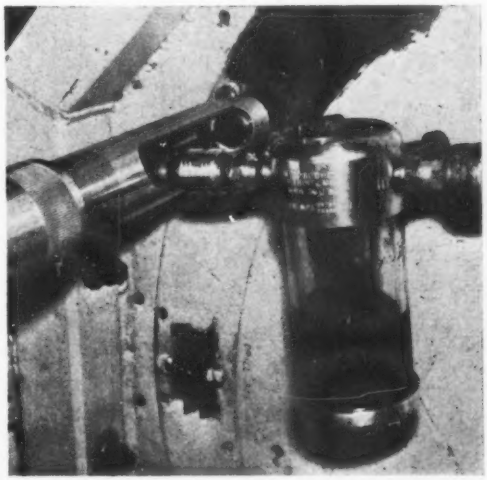


Fig. 3. A typical method of mounting the equipment for the supply of coolant mist to the liquid-tight coupling within the drill extension

Special Baker Machine for Operations on Gudgeon Pins

Baker Bros., Inc., Toledo, Ohio, U.S.A., have built two special multi-spindle machines, for operations on gudgeon pins, which have been installed in the works of leading American motor car manufacturers. A general view of one machine is given in Fig. 1, and it has an output of 768 gudgeon pins per hour at 80 per cent efficiency. There are five main units, namely, a trunnion fixture and two motor-driven cut-off heads, which are mounted on a common central base, and two multi-spindle cutter heads, supported on wing bases at either end of the main base. Both multi-spindle heads are of the standard Baker type, and are moved on the round guide-members of 30 × 24 saddle units by hydraulic cylinders. The head at the left in Fig. 1 has 20 cutter spindles, on fixed centres, which run in ball bearings, and the head at the opposite end of the machine is of similar design, but has 28 spindles, four of which are over-driven and mounted in independent, hydraulically-traversed quills.

The machine produces gudgeon pins, ready for the final grinding operations, direct from SAE 1017 bar stock. Two bar feed magazines are fitted at each side of the machine, and the bar supports for one magazine are indicated at A in Fig. 1. The supports may be seen more clearly in Fig. 2, and two stacks of bars can be loaded, one above the other, between the three prongs of each support. There are three supports on each side of the machine, and they are connected by two horizontal shafts, which are coupled to hydraulic cylinders on the central support. The shafts carry cams which normally engage the lowermost bar in each stack, and prevent it from being advanced by gravity to the feeding rolls. When a bar in the feeding position has been sufficiently reduced in length, a limit switch is tripped, and through a solenoid valve, the hydraulic cylinder is actuated to turn the horizontal shaft, so that the cams mounted thereon release the lowermost bar in the stack.

Bars from the upper and lower stacks on both sides of the machine are advanced simultaneously by the feed rolls, which are arranged in groups of four. In each group, the rolls are arranged in

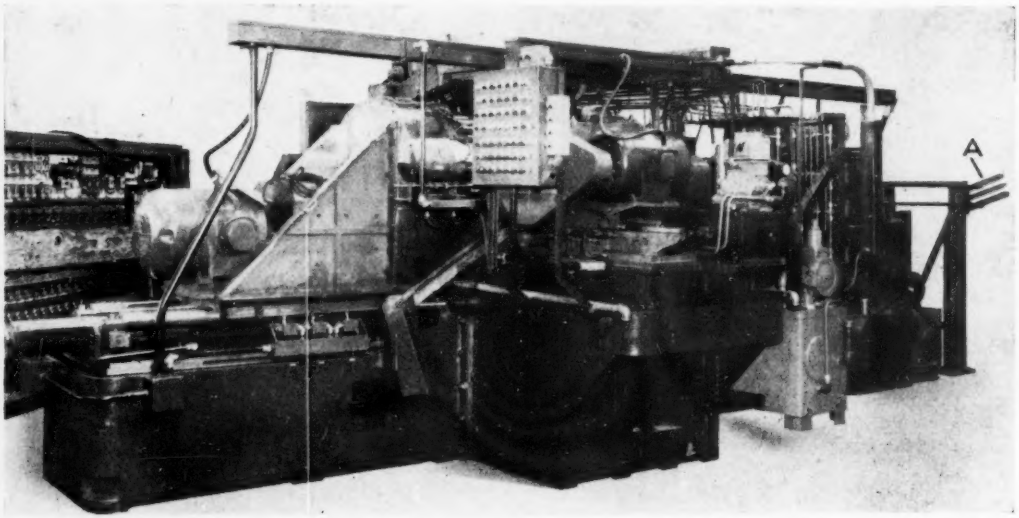


Fig. 1. General view of the Baker machine for operations on gudgeon pins, which incorporates two standardized multi-spindle heads, and a central base that supports a trunnion fixture and automatic saws

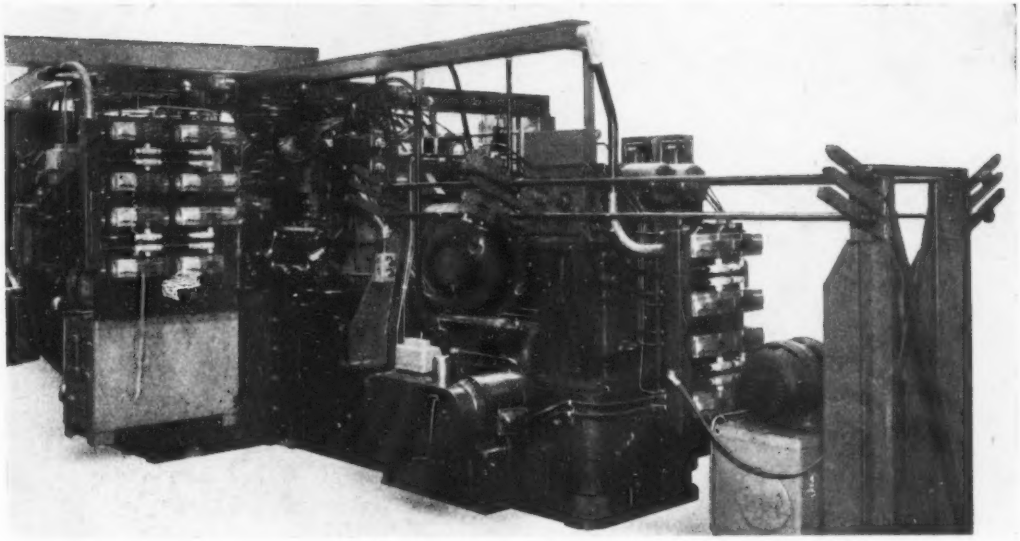


Fig. 2. One end of the Baker machine showing the magazine and feed mechanism for the delivery of bars of work-material to the automatic saws on the central base

pairs—an upper drive roll and a lower idler roll—and for convenience, the pairs of rolls are offset. There are two driving motors, and each is coupled to the two driven rolls at one side of the machine. The housings for the upper roll shafts are arranged to pivot, and can be moved downwards by hydraulic cylinders to engage the upper rolls with the bars of work-material, which are thus fed forwards.

The trunnion fixture of the machine has 18 stations, at each of which there are two holes with bushes to receive the workpieces. Hydraulically-operated clamping arrangements are incorporated to secure the workpieces in the seating bushes. A close-up view of the trunnion fixture is given in Fig. 3, and a pair of bushes is indicated at *A*. The pair of bushes immediately below those at *A* is hidden by a hydraulically-operated ejector unit *B*, and below this unit there is an end-stop *C*. This stop is one of two at the loading position on this side of the machine, similar stops and an ejector

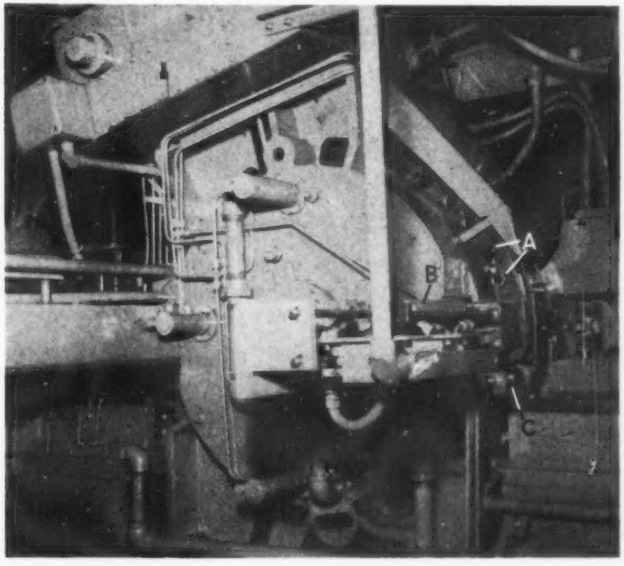


Fig. 3. Close-up view of the central trunnion fixture showing one of the hydraulically-operated ejector units. Workpieces are held in seating bushes in the fixture by hydraulic clamps

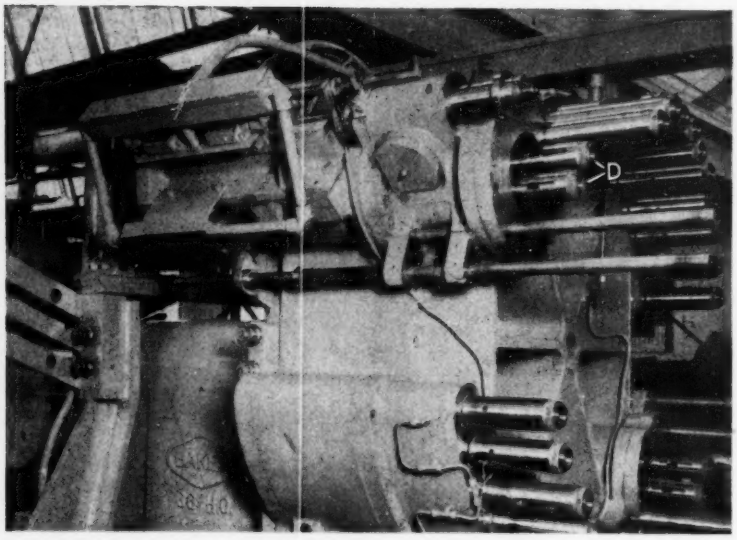


Fig. 5. Close-up view of the 28-spindle Baker head which incorporates over-driven and independently traversed spindles for the final reaming stage. The quills that house these spindles are advanced and withdrawn by hydraulic cylinders

unit being provided at the other side of the machine. From the loading position, at one side of the machine, a pair of workpieces is carried in a clock-wise direction (as viewed in Fig. 3), through seven cutting stations, and is ejected at the ninth station, one pair of workpieces moving above the horizontal plane that passes through the axis of the fixture, and the other pair moving below it.

The arrangements may be clarified by referring to the layout of the bush-plate (Fig. 4) for the multi-spindle head at the bar feed end of the machine. This bush-plate is cut away at either side to permit of feeding the bars and ejecting the machined workpieces. At the start of the machining sequence, the pairs of bars at each side of the machine are advanced into the fixture bushes, as indicated by dotted circles at station 1, until the ends of the bars contact the stops and the clamp members are then engaged. The sawing units at either side of the central base are next advanced, and a length of work-material sufficient to make one gudgeon pin is cut from each bar. After the sawing heads have been withdrawn, the fixture is indexed through 20 deg. to carry the lengths of bar to the first machining position. Since similar operations are performed on all four workpieces, only the pair that follow a path above the fixture axis need be considered.

A diagrammatic layout of the operation sequence is given in Fig. 6, and the cutting off stage is indicated at station 1. The saw employed is of 14 in. diameter, and it cuts through both bars simultaneously. Station 2 is idle, and at station 3, ⅝-in. diameter by ½-in. deep holes are produced in both ends of the blanks by drills mounted in the multi-spindle heads at either end of the machine. Each hole is extended to a total depth of 1⅛ in.,

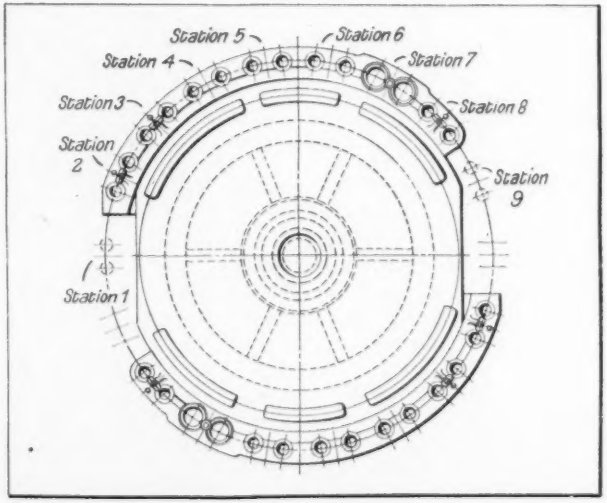


Fig. 4. Diagrammatic layout of the bush plate for one of the multi-spindle heads. The plate is cut away at each side for the passage of the bars of work-material and the machined gudgeon pins

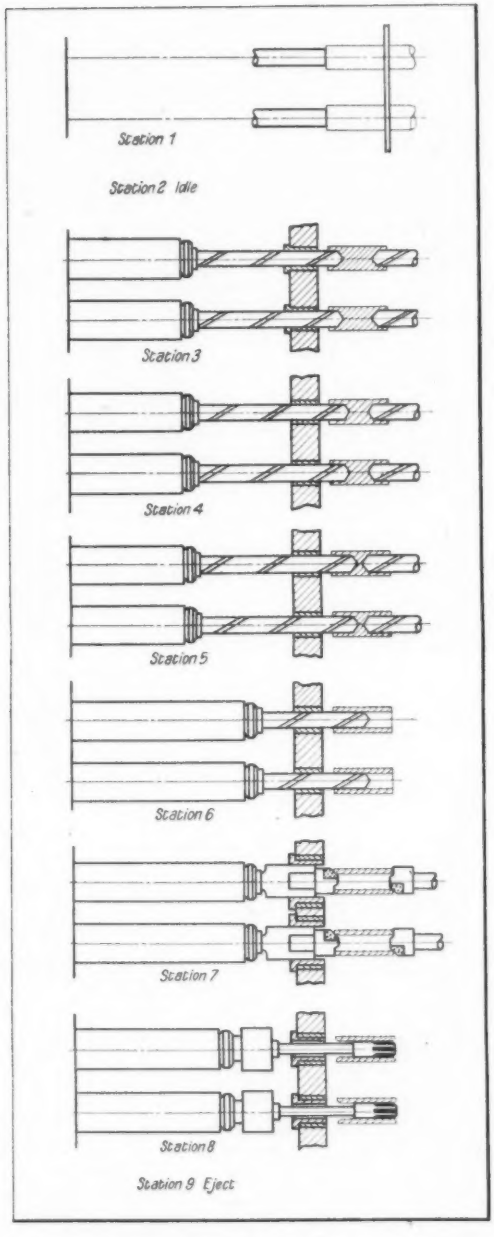


Fig. 6. The operations performed on the Baker machine are here shown schematically. Final drilling and the reaming stage are performed from one end only, but all other operations are carried out simultaneously from both ends. An output of 768 pins per hour is maintained at 80 per cent efficiency

in two stages, at stations 4 and 5, by ⅝-in. diameter drills mounted in each multi-spindle head. The workpieces are next drilled through at station 6 by ⅝-in. diameter drills in the left-hand head (as viewed in Fig. 1). At station 7, both ends of each workpiece are faced, and both ends of each bore are countersunk by special tools in both multi-spindle heads. The bores are finished by reaming from one end at station 8, the tools being mounted in one of the two pairs of over-driven spindles provided in the right-hand head, Fig. 1.

These spindles are indicated at *D* in the close-up view, Fig. 5. As already mentioned, the spindles are carried in a quill, which is advanced and retracted, independently of the main head, by a hydraulic cylinder. Movement of the head is controlled by solenoid operated valves, which are actuated by limit switches, at the left-hand end of the head. These switches are tripped by adjustable dogs on an extension of the stop member *E*.

After the reaming operation, the pair of workpieces is advanced to station 9, where they are thrust out of the jig seating bushes by the hydraulically-powered ejector plungers. As they are ejected, the machined gudgeon pins are pushed into two delivery tubes, along which they pass to a work pan. The external surfaces of the gudgeon pins are finally finished by centreless grinding.

Baker Bros., Inc., are represented in this country by Wickman, Ltd., Fletchamstead Highway, Coventry.

TUNGSTEN CARBIDE APPLIED BY THE METAL SPRAYING PROCESS.—As a result of recent developments by the Metallizing Equipment Co., Ltd., Chobham, Woking, Surrey, tungsten carbide can now be used for hard-facing by the metal-spraying technique. The new Metco Thermo-Spray powder consists of tungsten carbide mixed with a suitable matrix, which, after fusing, provides a homogeneous coating on the parent metal. A deposit efficiency of the order of 93 per cent is obtained, with nearly 80 per cent of tungsten carbide.

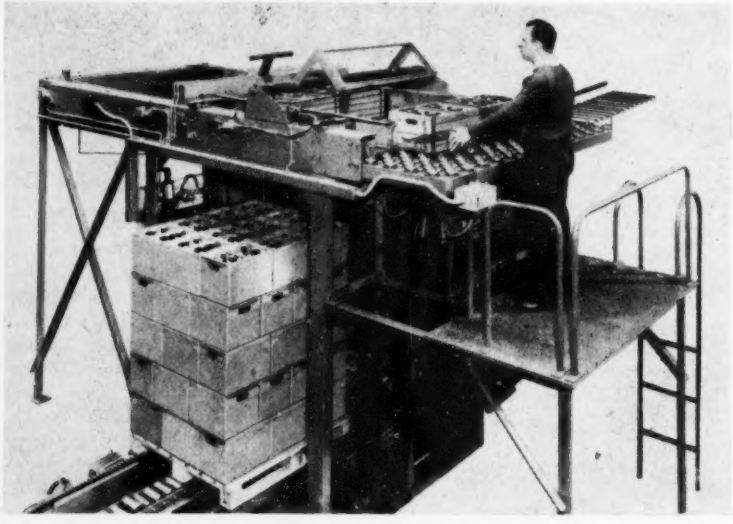
An important feature of this material is its low coefficient of thermal expansion, which avoids the risk of high stresses being set up during cooling. It is stated that the powder can be sprayed on to straight chromium steels without difficulty, and without the need for slow cooling.

Pantin Semi-automatic Pallet Loader

In order to facilitate the loading of a number of units on to a transporting pallet, W. C. Pantin, Ltd., Centre Drive, Epping, Essex, have developed the semi-automatic equipment here shown. The articles to be stacked are delivered by means of the roller conveyor at the extreme right, whence they are moved by hand on to the ball-type transfer table immediately in front of the operator. Here, one row is assembled into the required order for stacking and is then pushed away from the operator, to be delivered, by gravity, on to an apron immediately above the empty pallet. When a complete layer has been assembled in this manner, the operator presses a button which causes the apron to be withdrawn, thereby depositing the layer on to the pallet.

Following this movement, the pallet is automatically lowered by an amount equal to the overall height of the layer and the apron is advanced to its original position to receive the units forming the next layer. The process of placing layer after layer on the pallet continues until a stack has been built to the maximum capacity of the machine, or to a maximum height consistent with stability, and the pallet is then automatically discharged from the machine. At the same time, a fresh pallet is automatically introduced and raised to the full height beneath the loading apron. While these movements are taking place, the operator assembles a fresh layer. Empty pallets are loaded into the dispenser section of the machine in batches of ten, usually by means of a fork-lift truck.

The machine will handle pallets of the 2- or 4-way type, with bottom boards arranged in either direction, and will stack loads up to a maximum height of 70 in., including the pallet. Pallets with heights from 4 to 6½ in. can be used, with widths and lengths from 36 to 50 in. In certain circumstances, 2- and 4-way type pallets can be mixed. The maximum all-up weight of a loaded pallet must not exceed 3,000 lb., and that of an individual layer, 1,000 lb.



Pantin semi-automatic pallet loader

FABRON CONSTRUCTIONAL STEEL ANGLE—A range of constructional steel angle, in three basic sizes, and with a repeating pattern of ¼-in. diameter fixing holes, is being marketed under the name of Fabron by the Fabron Division of Hanworth Engineering (Aircraft), Ltd., Hanworth Road, Sunbury-on-Thames, Mddx. With this design of angle section, rigid joints, secured with a minimum of three bolts (and up to 16 bolts for larger sizes), can be obtained at angles of 30, 60, and 90 deg., the strength of the fixing bolts for any assembly being greater than that of the angle section used. The angle is available in 1½ by 1½, 2¼ by 1½, and 3⅛ by 2¼ in. sections, in cold-rolled half-hard mild steel, to BS. 1449, En. 2, the first two sizes being in 14 gauge, and the last in 12 gauge. It can be supplied with either a zinc metallized finish, for rust protection, or grey stove enamelled for interior use. Mild steel zinc-plated bolts, complete with nuts and self-locking washers, and a range of sizes of 20-gauge mild steel sheet for shelves, are also available.

New Production Equipment

Adcock & Shipley Double-headed Keyway and Cotter-hole Cutting Machine

The accompanying figure shows the size 1, double-headed, keyway and cotter-hole cutting machine which has recently been developed by Adcock & Shipley, Ltd., Ash Street, Leicester. While primarily intended for railway locomotive work, the machine can be employed for milling parallel keyways up to 1¼ in. wide and 12 in. long, and taper cotter slots, in a variety of components up to 7 in. diameter.

A double table, mounted on the substantial bed, is reciprocated longitudinally on guideways by an adjustable crank disc, to which it is coupled by a crosshead. The top table can be oscillated by an eccentric disc when taper cotter slots are being cut. This latter disc is mounted at the rear of the machine, and connected to the left-hand side of the top table by a link. Hand adjustment of 18 in. is provided for the table, which has a working surface of 48 by 12 in.

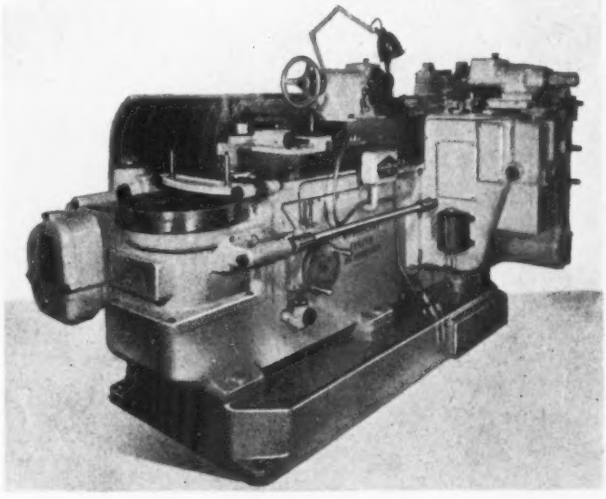
The cutter heads, which are traversed inwards on V-slides by the feed mechanism, have hand adjustment for setting purposes. Each cutter spindle is mounted in a pair of preloaded precision angular-contact ball bearings at the nose end, and in a roller bearing at the rear. Collets with capacities from ¼ to 1¼ in. diameter can be accommodated, and the maximum and minimum distances between the spindle noses are 15 and 4 in.

By adjusting the crank disc and crosshead connected to the lower table, the lengths and positions of the keyways or slots to be cut in the shafts can be varied, and vernier scales are provided to facilitate setting. The throw of the eccentric disc is also adjustable for controlling the angle of taper cotter slots, and the maximum taper obtainable is 1 in 8.

Compensating eccentrics are provided in the drive to the table reciprocating crank disc, which ensure a reasonably constant traversing speed. The rate of reciprocation can be varied by slip gears from 1·6 to 20 single strokes per min. Substantial locks are provided for securing the top table when the tapering motion is not required.

Drive is taken from a 5-h.p. totally-enclosed motor, through change-speed gearbox and gearing housed in the bed, and finally through splined shafts, to the cutter spindles. There are six spindle speeds from 227 to 1,200 r.p.m. In-feed of the heads at the end of each stroke is applied by a ratchet and pawl arrangement operated by a cam on the vertical shaft of the table reciprocating crank disc. The amount of in-feed per stroke is adjustable, by small increments, from 0·005 to 0·050 in.

The mechanism for controlling the in-feed is so arranged that it can be operated from the front position, and provision is made for using one cutter head only, or both heads simultaneously when



Adcock & Shipley, size 1, double-headed keyway and cotter-hole cutting machine

producing double keyways. For cutting slots, provision is made for reversing the feed drive to the rear head during the final stage, while the front cutter continues to advance to remove the centre web. The feed is then stopped, and the heads are returned to dead stops by hand.

Splash or pump lubrication is provided for the gearboxes, and the tables ways are lubricated by a one-shot system. Equipment provided includes a tailstock, self-centring vice and bearing-type workholders, which accommodate diameters up to 4¾ in. The height to the work centres is 45 in., and the spindle centres above the table is 7 in. A floor space of 101 by 62 in. is required for the machine, which weighs approximately 3¼ tons.

Bath High-speed Automatic Metal-forming Machines

Machines of the type shown in the accompanying illustration have been built by the Cyril Bath Co., Solon, Ohio, U.S.A., and supplied for use at the Dearborn, Michigan plant of Ford Motor Co., for forming air ducts of the type seen inset, at a rate of approximately 1,500 per hour. Sheet steel blanks of a special cross-section are employed, and each blank has a flange along each long edge, the flanges projecting in opposite directions. After a stack of blanks has been placed on the sloping platform seen at the front of each machine, all the remaining operations are performed automatically. The blanks are separated and delivered one at a time to the forming dies, and a pair of forming wings are automatically-actuated to tangent-bend the duct to the required shape.

As the forming wings return to their original position, the part is automatically ejected and discharged, by way of a chute, to a conveyor. Meanwhile, a fresh blank has been separated from the stack, and loaded into the dies. A stop is provided which is operated automatically should an oversize blank be encountered, or if more than one blank at a time is placed in the dies. All the moving parts of the machine are pressure lubricated.

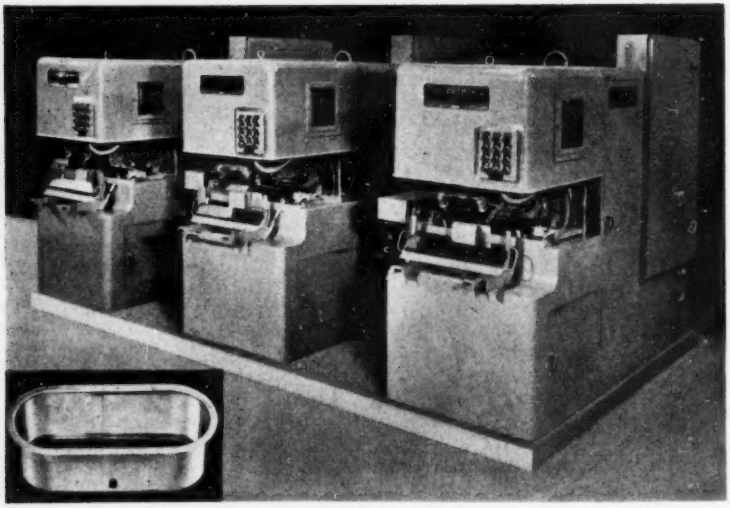
It is stated that with these machines, the position and degree of flatness of the flanged portions of the ducts can be accurately maintained, thereby simplifying the subsequent welding operations.

The agents for the Cyril Bath Co. in this country are Gaston E. Marbaix, Ltd., Devonshire House, Vicarage Crescent, London, S.W.11.

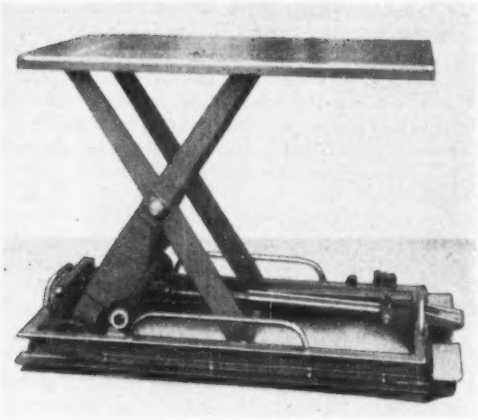
Sherpa Vertically-adjustable Hydraulic Table

Recently introduced by Salisbury Precision Engineering, Ltd., 1 Buckingham Palace Mansions, Buckingham Palace Road, London, S.W.1, the Sherpa vertically adjustable work table, here shown, will support loads weighing up to 1 ton, and maximum and minimum distances of 42 and 9 in. are obtainable between the shop floor and the 60- by 28-in. platform. If required, platforms of other sizes, or, alternatively, roller tables, can be provided.

Vertical movement of the table, at the rate of 5 ft. per min., is effected by a hydraulic cylinder, through an arrangement of arms which pivot on needle roller bearings. Fluid is delivered to the cylinder at 1,500 lb. per sq. in. pressure by a pump driven by a ½-h.p. motor. A waterproof plug and socket is provided for connecting the cable for the power supply. Raising and lowering of the table may be controlled by pedals, or remotely, by push-buttons. Made from channel-section steel, the base is supported at the front end by feet, and at the rear by 6-in. diameter cast iron wheels.



Bath high-speed automatic metal-forming machines



Sherpa vertically-adjustable hydraulic table

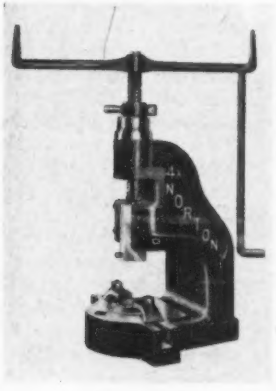
Wheels of other diameters, or castors, can be provided, if desired. A detachable towing handle, fitted with wheels, is supplied, which engages with a bracket at the front end of the base to permit the table to be readily transported. The weight of the table, excluding the towing handle, is approximately 4 cwt.

Norton 4X and 6X Fly Presses

The range of fly presses made by T. Norton & Co., Ltd., Carver Street, Birmingham, 1, has recently been extended to include the types 4X and 6X, both of which provide more working space than the normal standard machines, to enable larger tools to be accommodated.

In the figure is shown the 4X unit, which admits 8 in. between the T-slotted base and the ram guide, and has a throat depth of 7½ in.

On the 6X press, which has a throat depth of 9½ in., the distance from the base to the guide is also 9½ in.



Norton 4X fly press which accommodates comparatively large tools

New Ficep Bar Shearing Machines

The Beton type B.26 portable bar shearing machine shown in the figure has recently been added to the Ficep range marketed by Thos. W. Ward, Ltd., Albion Works, Sheffield.

It enables mild steel bars up to 1-in. diameter and 1¾- by ½-in. cross-section to be cut, and has an operating speed of 120 strokes per min. Drive is taken from a 1½-h.p. motor, through V-belts, to the flywheel, and thence by gears and a pedal-actuated rolling-key clutch which can be set for single-stroke or continuous operation. The machine weighs approximately 5 cwt., and is supplied with a detachable towing bar so that it can readily be moved. Beton bar shearing machines are now available in five sizes, the largest of which has a capacity for cutting mild steel bars up to 2⅜ in. diameter.

Ficep Beton type B.26 portable bar shearing machine

Another new Ficep shearing machine, known as the Colt, can be supplied in three types, one of which (type 1) has a capacity for cutting mild steel bars up to 3½ by ½ in. cross-section, and slitting mild steel plates up to ⅜ in. thick. The type 2 machine has separate shearing and cropping blades which will cut mild steel bars up to 1¼ in. diameter and 1⅛ in. square. Interchangeable cropping blades can be supplied for handling special shapes, also angle and T-sections up to 2½ by 2½ by ¼ in. The third machine has provision for cutting notches up to 1¼-in. wide and in $\frac{5}{16}$-in. thick mild steel plates.

Drive on each machine is taken from a 2-h.p.

motor, through a lever-controlled rolling-key clutch and gears, and the operating speed is 70 strokes per min. A wheel-mounted cabinet base, also a foot-operated solenoid control unit, can be supplied if required.

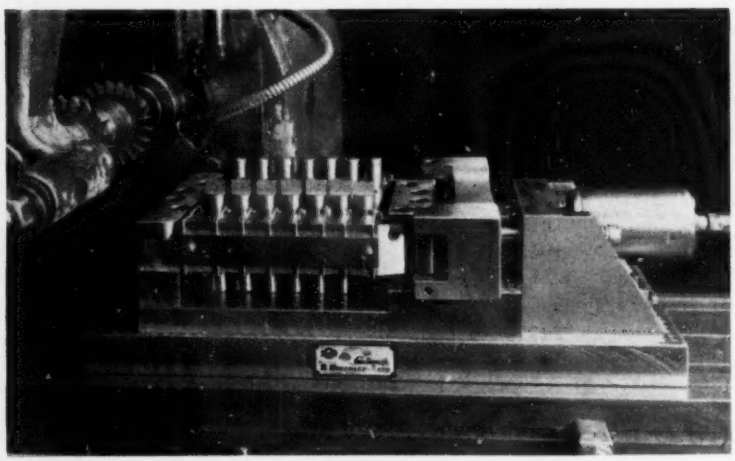
Autogrip Air-hydraulic Milling Fixture for Cylindrical Parts

Recently introduced by Z. Brierley, Ltd., Llandudno, the Autogrip type 9-AG milling fixture for cylindrical parts, here shown, is of basically similar design to that described in MACHINERY, 92/797—4/4/58, but is arranged for operation by an air-hydraulic cylinder, and provides for holding two rows of workpieces. It will accommodate, for instance, 28 components of ¼-in. diameter or 14 of ¾-in. diameter.

Workpieces are gripped vertically between a central block, and a number of rollers which are held in contact with the outer, pivoted, clamping arms, by wire clips. These clips are retained by slotted plates attached to the clamping arms, and permit small movements of the contact rollers so that they can accommodate themselves between the workpieces. With this arrangement, when the arms are swung to the closed position and tightened, similar clamping forces are applied to all the workpieces, irrespective of any small diameter variations.

Clamping force is applied to the arms by a yoke attached to the piston rod of the air-hydraulic cylinder which is mounted on the 21- by 8½-in. base. This yoke carries two vertical hardened-steel rollers which engage with inclined outer surfaces at the unrestrained ends of the arms, so that a wedging action is exerted. Return movement of the yoke is obtained by means of springs. A swing stop is fitted which can be set so that the yoke is moved only through a short distance for releasing the work, or clear of the clamping arms, which can then be swung outwards to afford access for cleaning.

The fixture weighs 197 lb., and has an overall height of 6 in. A type 8-AG fixture of similar design and capacity, but with a screw-operated yoke, is also available.



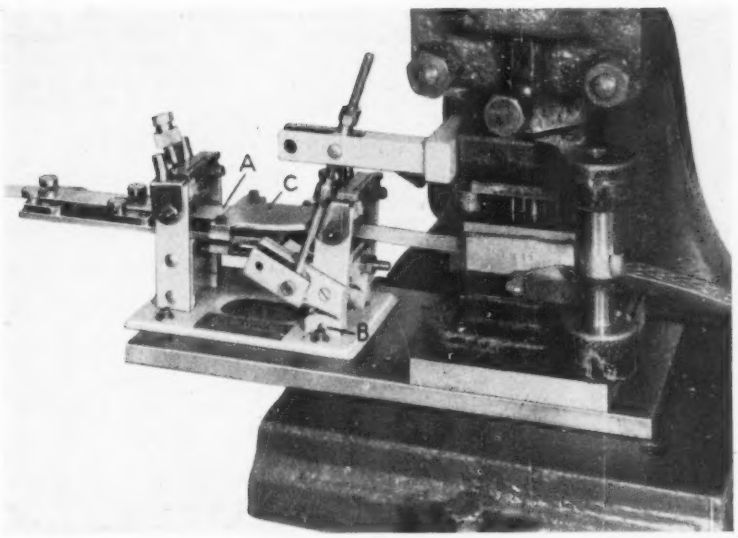
Autogrip type 9-AG air-hydraulic milling fixture for holding cylindrical parts

Carter Roller-ramp Coiled Stock Feeder

Carter Screw & Engineering Co., Datchet, Bucks., have recently introduced the coiled stock feeding attachment shown in the accompanying illustration, for use with presses operating at speeds up to 500 strokes per min. The attachment, in its present form, will handle flat stock up to 2 in. wide by 0·090 in. thick, the maximum forward feeding movement, with suitable material, being 2 in. This unit weighs 6 lb. complete and is simple in design, the rollers and other moving parts being so located as to be easily accessible for maintenance.

Stock enters the feeder between two pairs of adjustable guides, seen at the left, passes through a roller assembly, to emerge at *A*, thence under a roller release plate, and between a second pair of rollers mounted between the side members of a bracket pivoted at *B*. An arm secured to the upper bolster of a die-set is linked to the pivoted bracket by a tie-rod, to provide movement for feeding the stock forward. The movement can be varied by altering the effective length of the tie-rod, for which purpose adjusting nuts are provided.

Stock is gripped between the rollers in the pivoted bracket, and fed forward, during each return stroke of the press ram. The lower roller acts as a support for the stock and is free to rotate on a fixed spindle, whereas the upper roller has a small amount of longitudinal travel. An



Carter roller-ramp coiled stock feeder

inclined plate, or ramp block, is held down by light spring pressure against the upper roller, which, in turn, bears on the stock. Any movement of the roller assembly in a forward direction has the effect of immediately intensifying the grip of the rollers on the stock due to the wedge action which occurs when the travel of the upper roller is arrested by the ramp block. On the downward stroke of the press ram, the pivoted bracket is tilted back, and contact between the upper roller and the ramp block is interrupted. Consequently, the stock is freed from the grip of the roller assembly. A release plate at C provides for positively freeing the roller from the ramp block.

Rollers in the fixed bracket on the left of the baseplate, which also have a ramp action, serve to arrest the stock during the return movement of the pivoted bracket.

One of these feeder units was demonstrated at the recent E.I.A. Exhibition, on a press operating at a speed of 520 strokes per min.

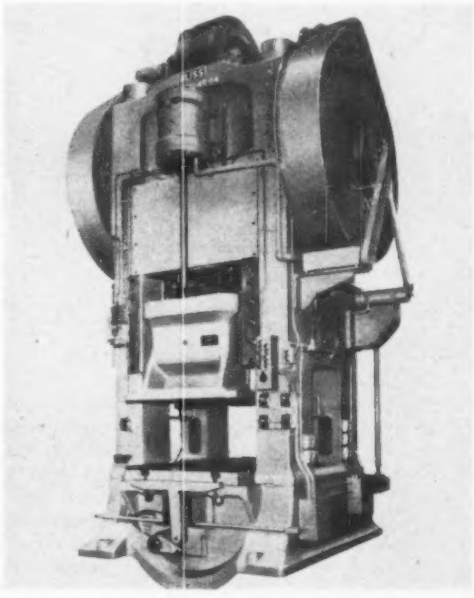
Bliss 1,000-ton Double Knuckle-joint Press

Introduced by the E. W. Bliss Co., Canton, Ohio, U.S.A., the type K2, 1,000-ton capacity press, here shown, incorporates a double knuckle-joint operating mechanism.

Claimed to be the first of its type yet built, the press is of straight-sided, tie-rod construction, and is intended for performing multiple coining operations on parts which may be widely spaced on the 48- by 84-in. bed. A 9-station transfer mechanism with a feed stroke of 9 in., which operates from front to rear of the bed, can be supplied. The feed bars can be adjusted for centre distance, and, if required, two pairs can be employed when small parts are to be handled.

Knuckle joint assemblies are provided at the front and rear to provide uniform 2-point loading of the ram for heavy coining operations. These knuckle assemblies "break" inwards towards each other, and are operated by links from a slide mounted between them. The ram has a stroke of 8 in. and a motorized adjustment of ½ in.

Drive is transmitted to both ends of the crank-



Bliss 1,000-ton double knuckle-joint press

shaft through single-stage helical gears which run in oil baths. Low-pressure cascade lubrication is provided for the knuckle joints, and there is a high pressure system for the lubrication of other important bearing surfaces.

E. W. Bliss (England), Ltd., City Road, Derby, represent the makers in this country.

Kennametal Cutmeter

In the accompanying illustration is shown a new portable computer which has been developed by Kennametal Inc., Latrobe, Pa., U.S.A., for the

Kennametal Cutmeter portable computer

evaluation of metal cutting conditions. This instrument, which is known as the Cutmeter, incorporates dials and rotary switches on which may be set the type of material, the depth of cut, feed rate, surface speed, and horse-power, for example, and it can be employed for analyzing the results which have been obtained from cutting tests or for determining optimum cutting conditions for new work.

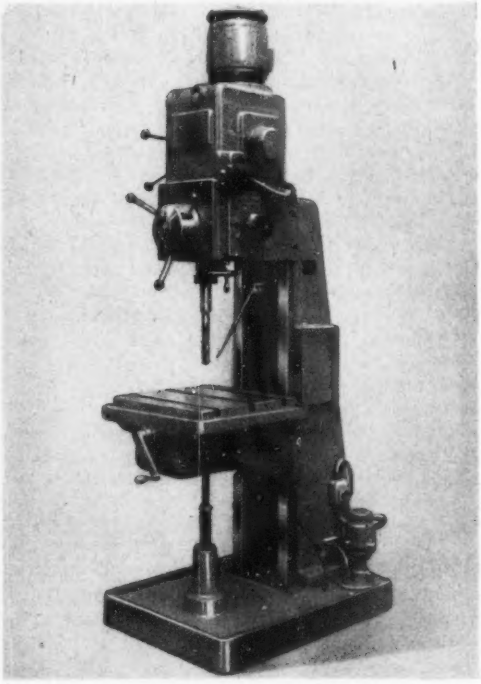
Charts are provided to indicate the allowances which must be made, when setting the computer, to accommodate unusual tool geometry, and wear at the cutting edge. The instrument weighs 8 lb., and is supplied complete with a carrying case measuring 5½ by 10½ by 14½ in.

George H. Alexander Machinery, Ltd., Socket Screw Division, Guns Lane, West Bromwich, Staffs., are the agents in this country for Kennametal, Inc.

Kerry Type C15 Drilling Machine

The type C15 drilling machine, shown in the accompanying figure, has recently been introduced by Qualters & Smith, Ltd., Barnsley—a member company of the Kerry Group.

It has a capacity for drilling holes up to 1½ in. diameter in steel and 1¾ in. in cast iron, and the nine reversible spindle speeds normally range from 90 to 1,120 r.p.m., drive being taken from a 2½-h.p. motor, flange mounted on top of the gear box. Alternatively, spindle speeds ranging from 60 to 750 or from 120 to 1,500 r.p.m. can be provided. The speeds are selected by levers on the gear box, and for starting, stopping and reversing the spindle there is a conveniently-placed switch. Of nickel-chrome steel, the gears are automatically lubricated by a built-in pump, and the shafts on which they are mounted run in ball bearings. The spindle is bored to take a No. 4 Morse taper shank.



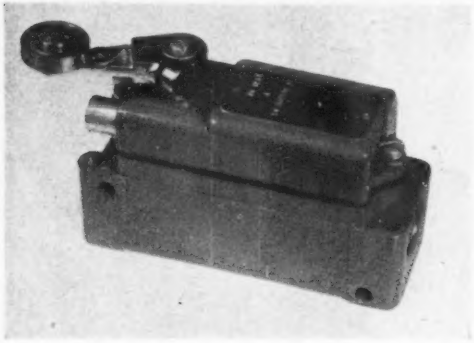
Kerry type C15 drilling machine

Three rates of power feed, namely, 0·004, 0·008 and 0·016 in. per spindle rev., are selected by a knob on the side of the head, and an adjustable trip is fitted to facilitate drilling holes to predetermined depths. A suds tank is incorporated in the base, and a motor-driven coolant pump is provided. A compound work table can be supplied.

Roller Arms for Square D Limit Switches

Square D, Ltd., 100 Aldersgate Street, London, E.C.1, have a selection of roller arms incorporating life-time lubricated ball bearings for use with their class 9007 type A limit switches.

Interchangeable with the standard types, these new roller arms are intended for applications, on machine tools and similar machinery, involving



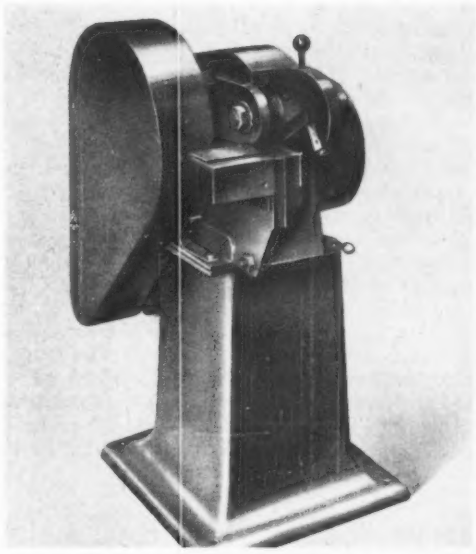
Square D limit switch fitted with a ball-bearing roller arm of new design

continuous rolling contact with the cam tracks. Arms are available with lengths of 1⅜, 2, 2½, and 3 in., each with a ¾-in. diameter roller.

Goliath Power Shear for Slotted Angle Sections

Shown in the figure is the Goliath power shear, recently introduced by William Urquhart, 1,023-1,027 Garratt Lane, London, S.W.17, primarily for cutting slotted angle sections. It will also handle non-slotted angles up to 3 by 2 in. by 12 s.w.g. in mild steel, and flat bars.

The subject of a patent application, the machine has been developed from the company's hand-operated shear, and can be supplied for bench mounting or with a box-section base, as illustrated. Drive is taken from a 1-h.p. motor, through V-belts to the flywheel, and thence through a clutch and



Goliath power shear for slotted angle sections

gearing. The operating cycle is started by pressing a plunger, and the clutch is automatically disengaged at the end of the return stroke of the pivoted arm which carries the shearing blade.

A machine of similar design is being built for cutting steel reinforcing rods and flat bars.

Martindale Bearing Wedges

The accompanying figure shows a bearing wedge representative of a new range which has been introduced by the Martindale Electric Co., Ltd., Westmorland Road, London, N.W.9. These wedges are intended for use in conjunction with the firm's range of twin-grip pullers, which was described in MACHINERY, 92/442—21/2/58, for

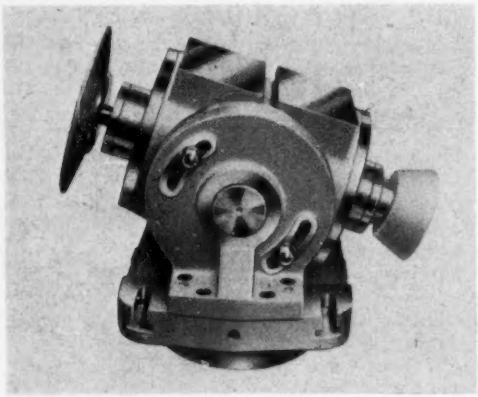
Martindale bearing wedges are here shown in use in conjunction with a Martindale twin-grip puller

removing a bearing or sprocket, for example, from a shaft, when the inner face of the former is too near an adjacent part to admit the fingers of a standard puller. The outer face of each half of the wedge assembly is flat, and the inner face is concave with a finely tapered edge. With the two halves embracing the part to be removed, the tapered edges are introduced between its rear face and the adjacent member. Next, the puller unit is attached to the wedge in the manner shown, and pressure is applied to the end of the shaft by means of the centre screw.

By means of the studs and nuts provided, the wedge members are brought closer together while pressure is maintained on the puller. The wedges ensure an all-round, evenly-distributed, thrust on the back face of the part, which is removed without damage. These bearing wedges are made in three sizes, with capacities from 0 to 2¼, ½ to 4¼, and 1 to 5¾ in. diameter.

Boneham & Turner Tilting Head for Cutter Grinders

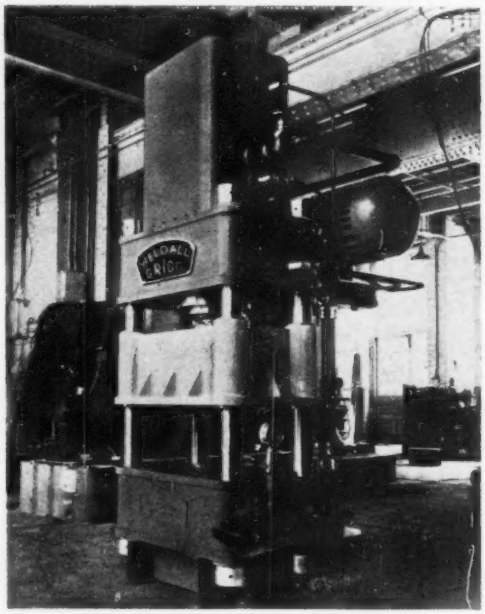
Intended for use on existing tool and cutter grinding machines, the tilting wheel-head shown in the figure has been introduced by Boneham & Turner, Ltd., Nottingham Road, Mansfield, Notts. The unit is self-contained, a balanced motor being mounted directly on the spindle, which can be tilted through angles up to 15 deg. in either direction. In addition, the entire head can be turned through 360 deg., and settings can thus be obtained for grinding cutters to the correct angles. The spindle has extensions at both ends for mounting grinding wheels. On 50-cycle mains supply the motor runs at 3,000 r.p.m.



Boneham & Turner tilting spindle head for cutter grinding machines

Weldall-Grigg 75-ton Hydraulic Press

The Weldall-Grigg 75-ton hydraulic press shown in the accompanying figure is one of a new range of 4-column units, which are being built by Charles S. W. Grigg, Ltd., Hanworth Road, Hounslow, Middlesex, in capacities from 50 to 5,000 tons.



Weldall-Grigg 75-ton, 4-column hydraulic press

Long guides are provided for the platen, which is lowered to the pressing position at high speed by means of a pre-fill valve in the oil tank. Provision is also made for rapid return, and the rates of movement during the various stages of the cycle can be adjusted. Oil is delivered to the double-acting steel cylinder at a pressure of 2 tons per sq. in. by hydraulic pumps which, together with oil tanks and auxiliary units, are housed in the crown. All the hydraulic equipment was supplied by Towler Brothers (Patents), Ltd., Rodley, near Leeds.

Presses can be supplied with various daylights, strokes, and bed areas, to suit requirements.

Mullard Machine Tool Control Using Linear Transducers

Mullard Equipment, Ltd., Mullard House, Torrington Place, W.C.1, have introduced a machine tool control system using linear measurement transducers which can be applied on a continuous basis for contour machining as well as for point-to-point positioning, for example, on a jig borer. A unit, designed to demonstrate the principle of the system, was shown by the company at the Electronic Computer Exhibition held at Olympia, London, from November 28 to December 4.

The transducer functions on a capacitance principle and consists essentially of a metal bar with an accurate thread of 0·100-in. pitch, produced by thread grinding, over which passes a metal sleeve with an internal thread of corresponding pitch. As seen in Fig. 1, the sleeve does not make contact with the bar, there being a clearance of few thousandths of an inch between the thread crests. The sleeve may be of ferrous or non-ferrous metal and is of split construction, the halves being spaced ½ pitch apart by an insulating ring. A block diagram of the control system for point-to-point positioning is given in Fig. 2.

The bar and sleeve are connected to an oscillator and bridge detector in such a manner that a series of nulls, equally spaced at 0·100 in. pitch, is produced in the electrical output from the sleeve.

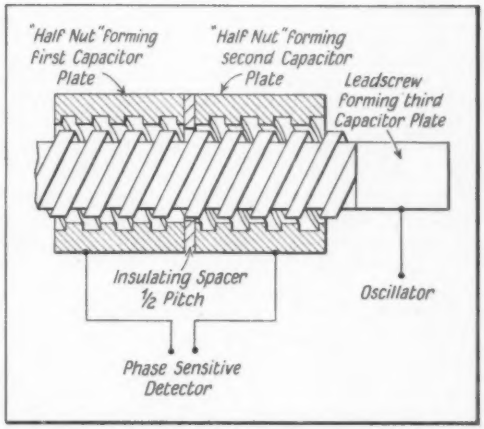

"Half Nut" Forming First Capacitor Plate
"Half Nut" Forming second Capacitor Plate
Leadscrew Forming third Capacitor Plate
Insulating Spacer ½ Pitch
Oscillator
Phase Sensitive Detector

Fig. 1. Sectional diagram showing transducer construction

These null points form an accurate "scale" which, in effect, can be moved along by rotation of the bar, a rotation of 0·36 deg. corresponding to a traverse of 0·0001 in. A separate coarse control is necessary to select the correct null point, and the scale of this system may be either a linear type potentiometer, or a rotary potentiometer coupled to a servo-motor driven lead screw which traverses the table. The inherent resolving power, which is a function both of the transducer and of the transistor detector circuit, is stated to be about 0·00003 in.

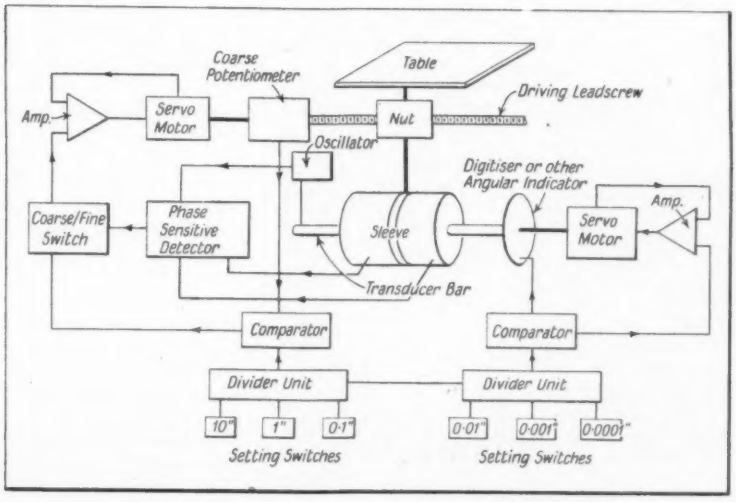


Fig. 2. Block diagram of a point-to-point control system incorporating a linear transducer

Errors in the machining of the bar are of two kinds, namely, local variations which, due to the averaging effect of the long sleeve, are extremely small, and cumulative errors over the whole bar. These cumulative errors are linear and for the highest accuracy requirements can be corrected out. It is stated that the overall accuracy can be as high as one part in 300,000.

When the transducer is used in a point-to-point system, the position required on each axis is set up on dials, or, alternatively, the information is fed into the control unit in the form of punched cards or tape, and the bar of the transducer is then rotated by the position motor to the appropriate angle. Upon depression of the start-cycle button, the machine table, to which is attached the transducer sleeve, is traversed by servo-motor at maximum speed, under the control of the coarse-system potentiometer, until a position is reached within ±0·050 in. of the required point. Once the table is within these limits, control is switched to the precision transducer, which has already moved its scale of electrical null points by the correct amount. The machine table movement continues until the output of the detector is zero, which indicates that the required setting position has been reached. Since the electrical output during this stage is proportional to error, the servo-motor drive slows down progressively, and there is thus no over-run of the table.

For continuous control applications, such as contour milling, a digital technique is recommended and a block diagram of one arrangement is given in Fig. 3. The bar of the transducer is continuously rotated in step with the command signals from a magnetic tape or other input medium from a computer. As the electrical "scale" moves along, the servo-motor drives the machine slide to maintain the error signal at zero. Rate information from the input signals is also applied to the servo-motor to assist the following operation. If the input information is in the form of a pulse train it is, of course, advisable to incorporate a form of parity check to provide protection against lost or spuriously-gained pulses.

Several important advantages are claimed for this positioning system. An accuracy of 0·0001 in., as demanded on precision machine tools, is well within its capabilities, it being possible to make the transducer components of a material having the same temperature co-efficient as that of the machine. Also, the transducer, together with the coarse-system potentiometer and angular-postioning servo mechanism, is built as one robust unit which can be sealed, although it is pointed out that the transducer system is insensitive to dust because of its inherent integrating principle. No wear can take place since there is no contact between the bar and the sleeve. For point-to-point positioning, all the necessary information is retained even if the power supply fails. In addition, the system allows the datum to be shifted to any chosen point, which is an essential requirement when handling large, heavy workpieces. The transducer can be made to virtually any length required, and it is thought that units as long as 40 ft. can be produced.

Present developments of Mullard Equipment Ltd., in this field include a standardized form of transducer unit incorporating a linear potentiometer for the coarse system, and a digitiser and servo-motor for rotating the bar, all of which are housed in a tube, the latter being about 4 in. diameter for most machine applications. The company can supply transducers or complete control systems, and the electronic circuits, which incorporate transistors for maximum reliability, can be housed in the machine, or in a separate cabinet.

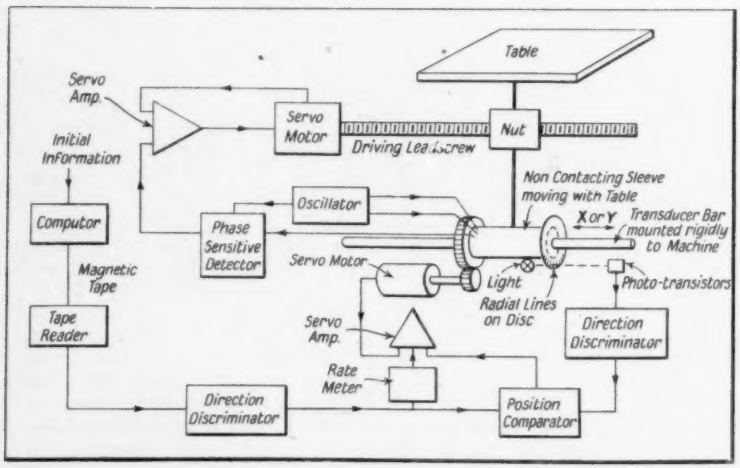


Fig. 3. One arrangement of a continuous control system using the linear transducer. The bar of the transducer is continuously rotated in step with command signals

Charles Churchill Demonstration

Machines and equipment for hobbing, shaving, induction hardening, and testing of gears on a production basis, were demonstrated recently at the showrooms of Charles Churchill & Co., Ltd., Coventry Road, South Yardley, Birmingham. The machines included a Churchill-Cleveland Mark 4 Rigidhobber, type S815, a Churchill-Red Ring type GCU gear shaver, and a Churchill-Redman gear speeder, which are handled by the company. In addition, an involute tester made by J. Goulder & Sons, Ltd., Albany Road, Kirkheaton, Huddersfield, and the latest type GHM/1 induction gear hardening machine built by Delapena & Son, Ltd., Zona Works, Russell Place, Cheltenham, were on view.

For the demonstrations, spur gears with 42 teeth, of 10 diametral pitch, 20-deg. pressure angle, and $\frac{1}{8}$-in. face width, were cut, one at a time, from blanks of En.8B steel in a cycle time of 3 min. 25 sec., on the Churchill-Cleveland Rigidhobber. This machine, which was described in MACHINERY, 88/160—20/1/56, was set for operation on a "square" cutting cycle, and a hob speed of 260 r.p.m., and a feed of 0·008 in. per rev. were employed.

Next, the gear teeth were shaved on the Churchill-Red Ring machine (MACHINERY, 88/644—4/5/56) in a cycle time of 1 min. 21 sec. During the shaving cycle, two cuts each 0·002 in. deep, and a third cut 0·001 in. deep, were taken, and for a fourth table stroke, no cut was applied.

On the type GCU machine, upward movements of the table, for applying cut to the gear being shaved, are obtained by a differential mechanism, and controlled by a cam which is indexed at the end of each stroke by an air cylinder and a ratchet and pawl. Different cams can readily be fitted to enable a maximum of six 0·002-in. deep cuts, and a single 0·001-in. deep cut, to be taken on the work in succession, followed by as many as four table strokes without the application of any further cut. At the completion of the cycle, the table is automatically lowered in readiness for unloading the shaved gear. The lowered position of the table can be controlled by means of an adjustable quadrant plate at the front of the knee, so that a pre-set amount of backlash is obtained between the cutter and an unshaved gear. The machine can be set for conventional or diagonal crossed-axis shaving, and with the former method, a rocking motion can be applied to the table during the cutting and return movements, whereby crowned teeth are produced on the gear.

After the shaving operation, the gear teeth were induction hardened on the Delapena machine, which is shown in Fig. 1. An advantage claimed for this machine is that distortion of the gear teeth as a result of the hardening operation is reduced to a minimum, subsequent grinding being necessary only when exceptionally close tolerances are specified. It is stated, moreover, that formation of scale on the teeth during heat treatment is obviated, and that the hardness pattern is maintained consistently.

The machine has a capacity for spur, helical, and certain types of bevel gears, with integral shafts up to 20 in. long, diameters from 1½ to 26 in., face widths up to 6 in., and helix angles up

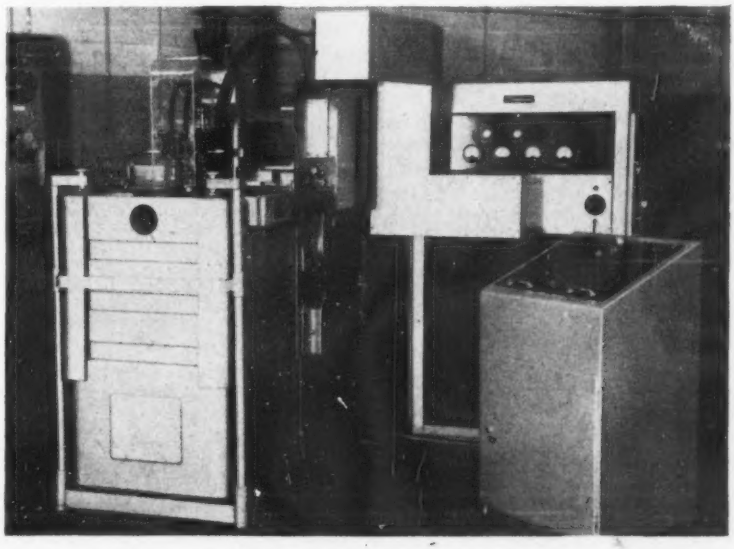


Fig. 1 Delapena type GHM/1 automatic induction hardening machine for gears

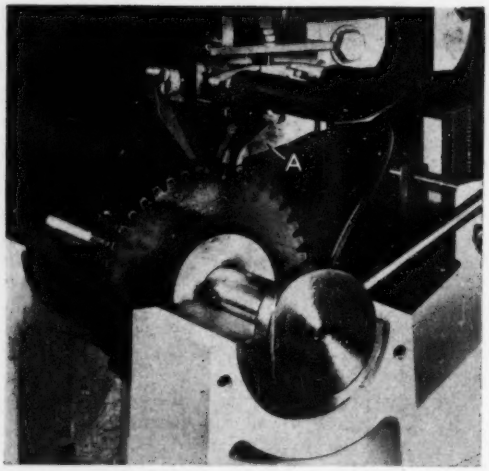


Fig. 2 Close-up view of a spur gear and the intensifier on the machine shown in Fig. 1.

to 30 deg. It is intended for use with a 25-kW. high-frequency generator for hardening of gears with diametral pitches from 2 to 10. Alternatively, a generator can be supplied which provides currents up to 15 kW. for continuous operation, and up to 25 kW. for intermittent working, when gears with a maximum of 4 D.P. are to be hardened. In the close-up view, Fig. 2, one of the gears which were the subject of the demonstrations is shown mounted on a mandrel, the latter being supported in half bearings incorporated in a pair of work carriers on the machine.

To start the automatic working cycle, a push button on the separate floor-mounted control unit is pressed, and a quench tank mounted on the front of the base is then moved upwards, so that the entire gear is immersed in water while hardening is in progress. Hardening is performed by means of a patent intensifier mounted on the lower end of the transformer. The slide which carries this assembly is traversed in guideways on top of the base by a motor-driven screw, and the intensifier is thus passed between the opposing flanks of two adjacent gear teeth, both flanks, and the root portion between the teeth, being hardened simultaneously. While hardening proceeds, water for spray quenching the heated surfaces is directed on to the flanks of the teeth by way of nozzles mounted close to the intensifier on both sides.

Indexing of the work, to present a fresh tooth space to the intensifier, is effected automatically, at the end of each hardening stroke, by means of a steel blade which engages with one of the teeth on the gear, and is operated by the oscillating motion of a horizontal shaft at the front of the bed. During the actual hardening operation, the gear is positively located, for angle, by a steel pin which engages with the flanks of a pair of teeth adjacent to those being treated. The gear may be indexed at both ends of the intensifier travel, to enable hardening to be performed during the forward and return strokes. Rapid power traverse can be applied to the transformer slide for a pre-set distance at the beginning of each stroke, and when the intensifier has been brought between the tooth flanks, the pre-set hardening speed is automatically engaged, and the high-frequency current is switched on.

When cluster gears, and gears with flanged portions close to the ends of the teeth, are to be hardened, the machine can be set so that indexing is carried out at only one end of the intensifier travel. Upon completion of indexing, the intensifier is rapidly traversed for the full width of the gear, whereupon the high-frequency current is switched on and heat-treatment is performed at the pre-set speed during the return stroke. Hardening may be carried out in this way during movement of the intensified in either direction. When helical gears are being hardened, rapid power traverse of the transformer slide is continued for a short distance after the high-frequency current has been switched on, until the intensifier has been brought into engagement with both tooth flanks to be treated. In this way, burning of the ends of the teeth is avoided.

The traversing speed of the transformer slide can be varied steplessly from ⅛ to 2 in. per sec., and settings for each direction of travel are made by means of dials on the control unit. Three shafts, mounted on top of the base, are fitted with adjustable stops, which operate micro-switches on the transformer slide during the cycle for controlling the working travel, switching on and off the high frequency supply at the beginning and end of each stroke, and for the automatic changes of traversing speed. A dial-type counter, mounted on the control unit, can be set to stop the machine when all the teeth on the gear have been hardened.

The transformer can be swivelled on the end of the slide, in the horizontal plane, for setting the intensifier for angle when helical gears are to be hardened. The arm *A* is then changed for another, fitted with a steel ball, which locates the gear for angle in relation to the intensifier, and causes it to be turned simultaneously with the traversing movement of the slide during the hardening stroke. When required, the entire transformer slide can be swung upwards to bring the intensifier clear of the

(*Continued on page* 1497)

News of the Industry

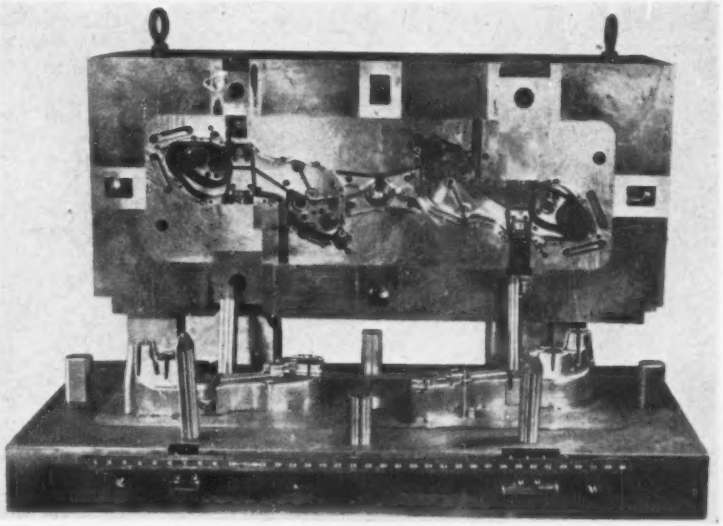
London and the South

SOAG MACHINE TOOLS, LTD., Juxon Street, Lambeth, S.E.11, inform us that their machine tool rebuilding works, where facilities are provided for the restoration of used machine tools of many types, are still busy. This company handles a wide range of new machine tools built in the U.S.A. and on the Continent. From the latter source, it may be noted, Rasmussen tube gilling machines are now being imported, and we are informed that the largest machine in the range can be used for applying gilling 1½ in. deep, at ¾-in. pitch, to 1-in. diameter tubing, at the rate of 6 sec. per foot.

J. K. SMIT & SONS (DIAMOND TOOLS), LTD., 22-24 Ely Place, Holborn Circus, E.C.1, are experiencing a steady demand for many types of diamond tools for use in mining, for example, also in precision engineering works. This company specializes in products which incorporate prepared diamonds selected for specific applications. These diamonds are employed for grinding wheel dressers, indenters for hardness testing machines, tools for turning metals and other substances, trepanning tools and rock drilling bits. The company has a research establishment where a variety of potential applications for diamonds is investigated and extensive production facilities.

SPEED TOOLS, LTD., Vereker House, Gresse Street, W.1, make a wide range of quick-acting clamps which are used extensively in the United Kingdom and in other countries. The Speetog jig clamp, for example, has a combined screw- and cam-action and is intended specially for incorporation in jigs and fixtures. A vertical lift clamp, introduced recently and designated ST210, is reported to be selling well. This clamp is provided with a linkage which moves the spindle in a vertical direction and enables clamping pressure to be applied through locating holes, for example, where a vertical approach is essential. Large stocks of all Speetog clamps are maintained.

TALBOT-PONSONBY & CO., LTD., Langrish, nr. Petersfield, Hants, have extended their premises by the addition of another bay, to enable the productive plant available to be used to greater advantage. This firm has specialized for many years in the production of pressure die casting dies, some of which are used in the manufacture of carburetters, also moulds of various types, for example, for the production of components in phenolic resins and other plastics. Other work includes moulds from which parts in wood or glass fibre are made, and the construction of specialized printing machinery. In co-operation with Matling, Ltd., Wolverhampton, the company also produces a range of handling equipment, including a 3-ton capacity platform truck for handling dies. For a special application, a machine of this type was constructed at these works for handling press tools weighing up to 12 tons. The assembly of other



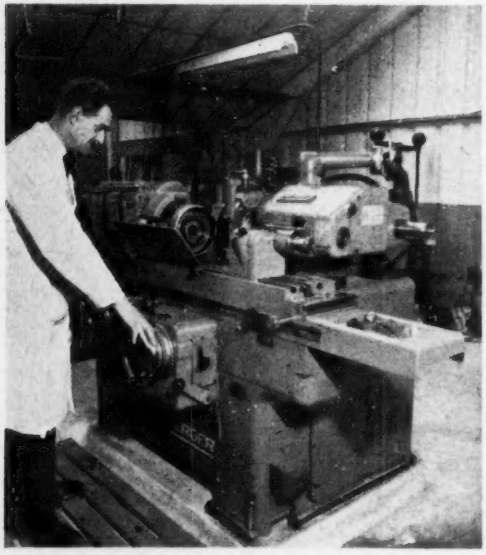
Two-impression die casting die made by Talbot-Ponsonby & Co., Ltd., for washing machine gear casings

equipment, such as remotely controlled devices used in nuclear investigation work, is also undertaken. The drawing office has been extended to provide additional facilities for designing.

With the installation of a number of new machine tools the equipment now provided in the works includes two Newall jig borers, also three Keller and two Deckel KF 12 die sinking machines for producing 3-dimensional cavity forms from masters. Among other recent additions may be noted an Elb surface grinder, a Taylor-Hobson pantograph machine, an Archdale 4-ft. 6-in. radial drill, and Gorton and Clarkson cutter grinding machines.

The accompanying illustration shows a 2-impression die casting die made by the firm. Employed for producing gear casings for domestic type washing machines, this die weighs 3 tons and measures 48 in. by 18 in. by 30 in.

CENTRAL ENGINEERS (HERNE HILL), LTD., Forsyth Road, Sheerwater Estate, Woking, Surrey, are well placed for orders for a wide range of gauges and specialized tooling equipment. An example of the former is seen in the accompanying illustration, which depicts a grinding operation on the external surface of a cylindrical gauge for checking the concentricity, at specified depths, of seals fitted to a prime mover. The gauge is being ground on a Kellenberger 50MU universal machine, which, with a Studer grinder, is used for producing work to very fine limits. A wide variety of gap, profile, depth, form, ring, plug, and receiver type gauges is produced for many industries, also moulds, jigs, fixtures, and tools. The works, it may be noted, are of recent construction and incorporate modern features, including floor heating by embedded electric elements, a high standard of artificial lighting, and a bus-bar trunking system for the distribution of power supplies to all points in the shop. A design office is shortly to be established.



A precision grinding operation in progress at the works of Central Engineers (Herne Hill), Ltd., Woking

F. W. H.

Letters to the Editor

[The Editor does not hold himself responsible for the views expressed by his correspondents.]

Factors Affecting Performance in Cylindrical Grinding

[*To the Editor of* MACHINERY]

SIR,—With reference to Mr. Wilding's letter, which was published in MACHINERY, 93/1260—25/11/58, I would say, first of all, that I do not advocate heavy in-feeds and hard wheels with oil, water emulsions for all grinding. I could find no statement of this kind in my article. Of necessity, the article was general and the principles of grinding were outlined to provide a better understanding of the process.

The basic principles, as indicated, and I quote from the article, are No. 8—For hard materials use soft grade wheels; No. 6—For finishing—Use slow traverse speeds, light in-feeds and higher work speeds.

These principles can be applied to Mr. Wilding's operation and, in substance, corroborate what he has indicated in his letter. To grind hard materials use light in-feeds with soft wheels.

I agree wholeheartedly that to obtain a crack-free surface on hardened material I would use a soft wheel and light in-feeds. I might or might not need a straight oil. A water-soluble oil might be satisfactory, depending upon the specific conditions of grinding. I might add that when these recommendations are followed, not only is cracking minimized but there is also a tendency to reduce the stresses in the ground surface.

Grinding fluids are definitely important and can influence wheel performance profoundly. In this connection I would draw attention to an article of mine which was published in *The Iron Age* for February 28 and March 7, 1957.

Our experience has shown that we can obtain check-free ground surfaces with water-soluble oils.

Apparently a particular combination of wheel and fluid will result in good quality grinding. It has been our practice to carry out cylindrical grinding wet to facilitate size control. With dry grinding it is difficult to hold work dimensions to the specified limits.

I fully endorse the statement that high-speed production grinding is not always satisfactory for producing surfaces without flaws.

I put this point rather differently, however. The customer should answer these questions: (1) Do you want to remove stock? (2) Do you want to generate a form? (3) Do you want to produce a good quality finish by grinding?

We can supply wheels for each purpose, and, as a rule, one wheel will not satisfy all three requirements. If the customer demands one wheel for all three purposes, there must be a compromise between the three operations.

To sum up then—(1) I do not advocate hard wheels and heavy in-feeds for all grinding. (2) I endorse the use of light in-feeds and soft wheels where check-free surfaces are essential. (3) I question the need for dry grinding to obtain check-free surfaces. (4) I subscribe to the view that high-speed production grinding is not always satisfactory for producing flaw-free components.

It is difficult to set down in a letter the factors that enter into the grinding process and to discuss their relation to the final ground part.

The fact that Mr. Wilding took the time to comment on my article is gratifying because it indicates that industry is interested in data of this kind. Without doubt, more such data should be available to the users of grinding wheels.

THE CARBORUNDUM CO.
John A. Muller, Manager, Grinding Laboratory, Product Engineering Branch
Bonded Abrasives Division
Niagara Falls, U.S.A.

ELECTRICITY GENERATING CAPACITY (maximum continuous rating) at the end of September, totalled 27,238 megawatts, compared with 25,692 at the end of September, 1957.

A view in the new foundry demonstration bay at the Bedewell Works of Baker Perkins, Ltd.

Baker Perkins Demonstration Bay

On December 3, Mr. J. F. M. Braithwaite, vice-chairman of the board of directors of Baker Perkins, Ltd., officially opened a new foundry machinery demonstration bay at their Bedewell works, Hebburn-on-Tyne. A general view of the bay is shown in the accompanying illustration, with the recently-introduced Taccone diaphragm moulding machine in the foreground on the left. A description of this machine was published in MACHINERY, 93/1301—3/12/58. At the right may be seen the turbo 60 rotating drum, rotating barrel, and rotary table shot blast machines, as built at these works, to which we hope to make further reference at a later date.

Charles Churchill Demonstration

(*continued from page* 1494)

gear. Knob-operated valves for adjusting the flow rate of the water for cooling of the transformer and the intensifier, and for spray quenching the gear teeth, are mounted on a tube-type indicator unit attached to the base. The vertical movement of the quench tank is controlled by adjustable stops. Intensifiers can be supplied to suit different gear pitches, and of designs which enable various portions of the tooth profile to be hardened to the same or different depths.

Industrial Notes

PRECISION COMPONENTS (BARNET), LTD., 13 Byng Road, Barnet, Herts., have introduced GripsOn self-adhesive letters and numerals for identifying the contents of their Kabi bench trays and storage bins, and for similar applications.

EMPLOYMENT IN THE MANUFACTURING INDUSTRIES.—The number of people employed in the manufacturing industries fell by 4,000 during October to 9,104,000. At the end of October, 1957, the total was 9,371,000. In October last, there was a decline of 3,000 in "engineering, metal goods, and precision instruments," of 2,000 in "vehicles," and of 1,000 in "metal manufacture."

J. M. HARGREAVE & CO., LTD., West Molesey, Surrey, are now operating an A.I.D. approved heat treatment service. Work which can be undertaken includes direct hardening, martempering, cyanide hardening, carburizing normalizing, annealing, and sub-zero treatment of small to medium size components.

DUNLOP GENERAL RUBBER GOODS DIVISION, Cambridge Street, Manchester, report that their Fortiflex rubber-resin compound is being used for the fabrication of materials handling chutes. It is stated that if these chutes become blocked, they can be easily cleared on account of their flexibility. They will not crack or corrode, have good resistance to abrasion, and are comparatively light.

DESOUTTER BROS., LTD., The Hyde, Hendon, London, N.W.9, inform us that they are now offering their portable electric power tools for sale direct to the retail market. The first four main distributors to be appointed are: Buck & Hickman, Ltd. (London and all branches); A. J. Howard (Southend); G. A. Robinson (Stoke-on-Trent), Ltd. (Stoke-on-Trent and Coventry); and Power Tools (Birmingham), Ltd. (Birmingham and London).

A HIRE SERVICE FOR THEODOLITES AND LEVELS has recently been introduced by W. F. Stanley & Co., Ltd., Avery Hill Road, New Eltham, London, S.E.9. Instruments available under this scheme include optical-micrometer-, vernier-, and contractors' theodolites; three types of dumpy levels, including the A352, 3-screw, heavy-duty engineers' level; and four types of precision levels. It is pointed out that companies can make use of this scheme to hire instruments during periods when their own are being repaired or serviced.

MARTONAIR, LTD., Parkshot, Richmond, Surrey, have opened two new branch offices. One of these, in the Central Administration Building, Team Valley, Gateshead, 11, also serves as an office for Mr. C. P. White, the company's technical representative in the North-Eastern Area. The other branch is at 46 Great Hampton Street, Birmingham, and replaces the former offices in the Holyhead Road. These new premises remain under the direction of Mr. R. A. Young, and the telephone number (Northern 7273) has not been changed.

G. D. PETERS & CO., LTD., announce that they have acquired the share capitals of Hancock & Co. (Engineers), Ltd., and Weldcraft, Ltd., and that these companies are now members of the Peters Group. Both companies will continue to operate under their original names, and Mr. L. J. Hancock and Mr. E. Seymour-Semper, M.I.Mech.E., will retain their positions as technical director and managing director, respectively, of Hancock & Co. (Engineers), Ltd. The chairman of the new board of directors of the latter company is Mr. H. J. Stretton, director and general manager of G. D. Peters & Co., Ltd.

CZECHOSLOVAK ECONOMIC NEWS SERVICE.—During the past year, the Czechoslovak Chamber of Commerce has been publishing a monthly report entitled "Economic News Service," in English and German, giving useful facts and figures concerning the country's imports and exports, and trade relations. Because of the interest that has been aroused by the issue of this kind of information, the scope of the report is to be extended, from January,1959, particularly with regard to Czechoslovak imports, and two exclusive articles or reports, specially compiled to meet a subscriber's requirements, will be issued free of charge each month, upon request. The 12 monthly reports for the coming year can be obtained from the Press Department, Chamber of Commerce, Prague 1 (price 21s., post free).

BIRFIELD GROUP UNIVERSITY SCHOLARSHIP AWARDS.—Starting in 1959, the Birfield Group of companies will offer three university scholarships each year, which will provide successful applicants with the necessary education and experience to become chartered members of one or more of the engineering institutions. Each scholarship will provide for a residential place at a university to read mechanical engineering, also an engineering apprenticeship, normally of two years' duration. Finally, the graduate will be offered a staff appointment within the Group to obtain the necessary two years' experience in a position of responsibility, to enable him to apply for corporate membership of an Institution. Application forms for this scheme can be obtained from The Warden, Birfield Group Conference Centre, Goldicote House, Stratford-on-Avon.

W. E. CUCKSON & SON, LTD., inform us that a further stage in their planned programme of expansion has been reached with the completion of a new wing at their factory on the Industrial Estate, Treforest, Pontypridd, Glam. The extension has enlarged the floor area available for production by some 20 per cent, and has enabled additional plant to be installed. Consequently the capacity for precision toolmaking and the production of special purpose machines and electro-mechanical assemblies has been considerably increased. The company undertakes work of this nature for the aircraft, steel, radio, plastics, motor vehicle, and general engineering industries. In addition, a larger drawing office has been provided to enable more design and development work to be undertaken, and improved facilities have been provided for prototype production. Advantage has been taken of the headroom afforded by the roof pitch to install a mezzanine floor along one side of the new building, and this space is utilized for electro-mechanical assembly work.

Personal

MR. AUSTIN G. REDDY, 50 Gloucester Street, Belfast (telephone number Belfast 29591) has been appointed representative in Northern Ireland for Grimston Electric Tools, Ltd.

MR. HAROLD BATEMAN has been appointed Yorkshire agent for Landis Lund, Ltd., Cross Hills, Keighley, for the sale of the present Precimax range of machine tools.

MR. E. MARLAND has been appointed commercial manager of the Capacitors and Resistors Division of The Plessey Co., Ltd., at Swindon. He was previously sales and commercial manager of the Wiring Division.

MR. G. N. VANSITTART, until recently chairman of General Motors (England), Ltd., has joined the board of directors of Production Tool Alloy Co., Ltd., Sharpenhoe, Bedfordshire.

MR. G. H. C. GOODBAN has been appointed to the board of The Press & Shear Machinery Co., Ltd., 172-178 Victoria Road, Acton, London, W.3, and will be responsible for sales and general management. He will remain a director of Elgar Machine Tool Co., Ltd.

MR. B. DAWKINS, B.Sc. (Eng.), A.M.I.E.E., has been appointed assistant manager of the Education Department of Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester, 17, for professional and technician apprentice recruitment and training.

MR. T. E. PARKINSON has been appointed a director of Elgar Machine Tool Co., Ltd., 172-178 Victoria Road, Acton, London, W.3, and holds the position of general sales manager. Until recently he was sales manager for Mortimer Engineering Co. and was previously with Sykes Machine Tool Co., Ltd.

Correction

In the advertisement for Martonair, Ltd., 14 Parkshot, Richmond, Surrey, which appears on p. 115 of this issue of MACHINERY, the company's telephone number is given incorrectly. It should be Richmond 2201.

Scrap Metals

†LONDON.—‡Prices per ton for non-ferrous scrap metals free from iron are as follows:—clean copper wire, untinned and free from lead and solder, £180; clean heavy copper, untinned and free from lead and solder, £170; copper wire, No. 2, £167; clean light copper, £157; braziery copper, £139; gunmetal, £142; brass, mixed, £100; lead, net, £57; zinc, £35; cast aluminium, £96; old rolled aluminium, £114; battery lead, £30; unsweated brass radiators, £90; hollow pewter, £505; black pewter, £375.

MIDLANDS.—Twelve months ago, trading in scrap showed signs of changing for the worse. There would now appear to be some evidence of slight improvement. Freedom of control on exports for two months will help conditions, and with a few loading permit labels being issued by home consumers, merchants feel that the future outlook is brighter than for some time.

Certain grades still present much difficulty, and this applies particularly to the large tonnages of chipped turnings which are produced in the Midlands. Recent issue of allocations for delivery of bushy turnings has stimulated trading considerably after months of stock piling by merchants. Cast iron borings can be moved for direct delivery but demand is only spasmodic.

As No. 4 hydraulically compressed bundles are in demand, many merchants are now accepting good deliveries of light steel cuttings at their yards. Light iron is still not wanted, because disposal of No. 5 bundles is difficult.

Little interest is shown in short heavy steel scrap, and only small regular allocations from foundries are fulfilled each week. Stocks of short heavy steel and stamping flash continue to grow.

Trading in cast iron scrap is keen and all grades can be placed without difficulty.

Alloy scrap, and particularly nickel scrap with a molybdenum content, is hard to sell.

Destructor bales are very hard to place and prices have fallen considerably. Loose destructor scrap for pressing has consequently ceased to be of interest to merchants.

Current maximum control prices, delivered consumers' works, are now: *Heavy steel No. 1, 217s. 6d.; *heavy steel No. 2, 196s.; *heavy steel No. 4, 207s. 6d.; *heavy steel No. 5, 195s. 6d.; light iron No. 8, 149s.; short turnings No. 9 (free from alloy), 167s. 3d.; light steel No. 11, 164s. 3d.; bushy turnings, 117s.; short alloy turnings, 160s. 9d.; short steel No. 2, 233s. 3d.; machinery cast, 233s.

Prices may be increased up to 2s. 6d. per ton according to quantities tendered over a given period.

* For use by Round Oak Steelworks, Brierley Hill, increase by 1s. 6d. per ton.
† George Cohen, Sons & Co., Ltd., 600 Commercial Road, E.14.
‡ Subject to market fluctuations.

The Price of a Subscription to MACHINERY is 52 Shillings per annum, post free, to any part of the world.

Subscribers are not bound for any definite period of subscription. We send MACHINERY, post free, each week until told to stop. Subscribers can pay yearly, half-yearly, or quarterly, pro rata. (Cash with order)

To MACHINERY, National House, 21 West Street, Brighton 1.

Please send me/us MACHINERY every week until I/we tell you to stop, for which I/we enclose remittance of 52 Shillings per annum or pro rata

Name .....

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**Firm* .....

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24/12/58

Trade Publications

CARTER GEARS, LTD., Thornbury Road, Bradford, 3. Leaflet No. DFC/1 gives details and dimensions of lever-type speed control units for use with F-type Carter hydraulic steplessly-variable speed gears. These control units can be fitted on either side of the drive, also in several angular positions.

R. H. COLE (OVERSEAS), LTD., 2 Caxton Street, London, S.W.1. Catalogue No. T Sv 1, covering a new range of small rectifiers manufactured by Siemens & Halske, München, Germany, for whom the company are the sole selling agents in the United Kingdom. These units have a higher rating, and have smaller physical dimensions, than previous types made by the same company, and in addition to their applications in radio, television, and other electronic equipment, are suitable for use in conjunction with DC-operated solenoid valves, magnetic actuators, and for similar purposes.

B.E.N. PATENTS, LTD., P.O. Box. No. 10, High Wycombe, Bucks. Leaflet No. CB.164 describes the type OS spray gun which is intended for use where intermittent or synchronized spray coatings are to be applied to materials while they are being transported by conveyors or other mechanical means.

The general layout of a typical installation for automatic spraying is shown, in diagram form, including the ancillary equipment required for the complete circuit.

Machine Tool Share Market

Stock markets, after remaining quiet and steady, became fairly active and firm, and the period under review closed on a cheerful note, with price changes mainly to higher levels.

In the gilt-edged section, the market gradually rallied to finish with modest gains among British Funds and similar high grade fixed interest stocks.

Commercial and industrial share markets developed a bright tendency, with the general trend upwards as a result of selective demand, and there were several prominent features, attributable to favourable company profit and dividend announcements.

Among machine tool issues, Asquith Machine Tool advanced 9d. to 24s.; Churchill Machine Tool, 3d. to 16s. 7½d.; and Geo. Cohen, 6d. to 11s. On the other hand, Brooke Tool lost 1½d. at 3s. 10½d.; Chas. Churchill, 1½d. at 5s. 10½d.; John Shaw & Sons (Wolverhampton), 1½d. at 15s. 6d.; and Thos. W. Ward, 3d. at 82s. 3d.

COMPANY		Denom.	Middle Price
Abwood Machine Tools, Ltd.	Ord.	1/-	9d.
Armstrongs, Stevens & Son, Ltd.	Ord.	5/-	8/9
Allen (Edgar) & Co., Ltd.	Ord.	£1	38/-
" "	5% Prf.	£1	15/6*
Arnott & Harrison, Ltd.	Ord.	4/-	15/-
Asquith Machine Tool Corp., Ltd.	Ord.	5/-	24/-
" " "	6% Cum. Prf.	£1	18/6
Birmingham Small Arms Co., Ltd.	Ord.	£1	35/-
" " "	5% Cum. "A" Prf.	£1	15/6
" " "	6% Cum. "B" Prf.	£1	18/-
" "	4% 1st Mort. Deb.	Stk.	88½
British Oxygen Co., Ltd.	Ord.	£1	43/9
" " "	6½% Cum. Prf.	£1	21/9
Brooke Tool Manufacturing Co., Ltd.	Ord.	5/-	3/10½
Broom & Wade, Ltd.	Ord.	5/-	11/3
" "	6% Cum. Prf.	£1	17/9
Brown (David) Corporation Ltd.	5½% Cum. Prf.	£1	15/6
Buck & Hickman, Ltd.	6% Cum. Prf.	£1	17/9xd
Butler Machine Tool Co., Ltd.	Ord.	5/-	10/-
" " "	5% Cum. Prf.	£1	13/9
C.V.A. Jigs, Moulds & Tools, Ltd.	5½% Red. Cum. Prf.	£1	11/3xd
Churchill (Charles) & Co., Ltd.	Ord	2/-	5/10½
" " "	6% Cum. Prf.	£1	26/4½
Churchill Machine Tool Co., Ltd.	Ord.	5/-	16/7½
" " "	6% Cum. Prf.	£1	18/3
Clarkson (Engrs.), Ltd.	Ord.	5/-	17/6
Cohen (George), Sons & Co., Ltd.	Ord.	5/-	11/-
" " "	4½% Cum. Prf.	£1	14/6
Coventry Gauge & Tool Co., Ltd.	Ord.	10/-	18/1½
" " "	5% Cum. Red. Prf.	£1	16/3
Coventry Machine Tool Works, Ltd.	Ord.	4/-	8/6
Craven Bros. (Manchester), Ltd.	Ord.	5/-	6/10½
Elliott (B.) & Co., Ltd.	Ord.	1/-	2/9
" "	4½% Red. Cum. Prf.	£1	13/9xd
Expert Tool & Case Hardening Co., Ltd.	Ord.	2/-	1/3
Firth Brown Tools, Ltd.	4% Cum. Prf.	£1	12/6
Greenwood & Batley, Ltd.	Ord.	£1	57/6
Harper (John) & Co., Ltd.	Ord.	5/-	16/9
" "	4½% Red. Cum. Prf.	£1	13/3
Herbert (Alfred), Ltd.	Ord.	£1	37/6
Holroyd (John) & Co. Ltd.	"A" Ord.	5/-	13/6
" " "	"B" Ord.	5/-	13/6
Jones (A. A.) & Shipman, Ltd.	Ord.	5/-	21/-
" " "	7% Cum. Prf.	5/-	5/-xd
Kayser, Ellison & Co., Ltd.	Ord.	£1	44/9xd
" " "	6% Cum. Prf.	£1	18/3
Kandall & Gent, Ltd.	Ord.	5/-	8/-
Kerry's (Gt. Britain), Ltd.	Ord.	5/-	6/10½
Kitchen & Wade, Ltd.	Ord.	4/-	13/9xd
Martin Bros. (Machinery), Ltd.	Ord.	2/-	1/10½
Massey, B. & S., Ltd.	Ord.	5/-	9/9
Modern Engineering Machine Tools Ltd.	Ord.	5/-	11/3
Newall Engineering Co., Ltd.	Ord.	2/-	4/6
Newman Industries, Ltd.	Ord.	2/-	2/9
" "	6% Prf. Ord.	5/-	5/6
Noble & Lund, Ltd.	Ord.	2/-	3/9
Osborn (Samuel) & Co., Ltd.	Ord.	5/-	19/6
" " "	5½% Cum. Prf.	£1	26/-
Pratt (F.) & Co., Ltd.	Ord.	5/-	22/6
Scottish Machine Tool Corporation, Ltd.	Ord.	4/-	5/3
Shardlow (Ambrose) & Co., Ltd.	Ord.	£1	39/-xd
Shaw (John) & Sons, Wolverhampton, Ltd.	Ord.	5/-	15/6
Sheffield Twist Drill & Steel Co., Ltd.	Ord.	4/-	14/-
" " "	5% Cum. Prf.	£1	15/-xd
Stedall & Co., Ltd.	Ord.	5/-	7/6
	"B" non-voting Ord.	10/-	22/6
Sykes (W. E.), Ltd.	Ord.	5/-	7/6
Tap & Die Corporation, Ltd.	4½% Deb. 1961-1977	Stk.	82/-
Wadkin, Ltd.	Ord.	10/-	18/9
Ward (Thos. W.), Ltd.	Ord.	£1	82/3
" "	5% Cum. 1st Prf.	£1	16/-xd
"	5% Cum. 2nd Prf.	£1	23/6xd
Willson Lathes, Ltd.	Ord.	1/-	2/4½xd

The Middle Prices given in the list are in several cases nominal prices only and not actual dealing prices. Every effort is made to ensure accuracy, but no liability can be accepted for any error. * Sheffield price. † Birmingham price.

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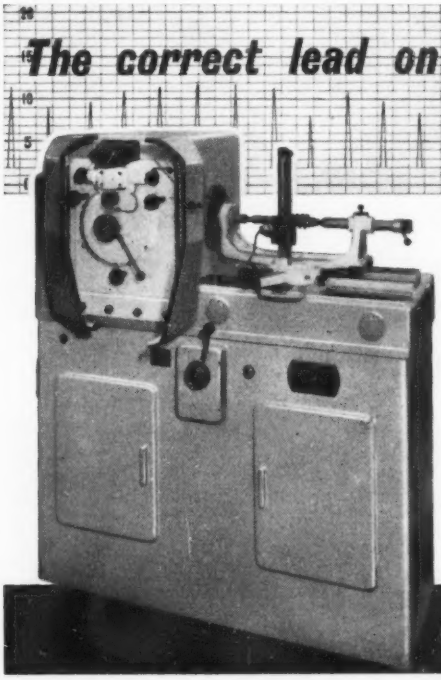

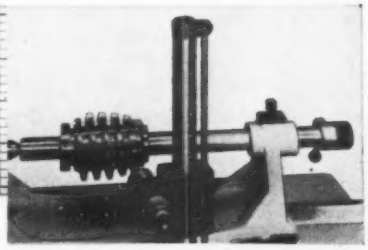

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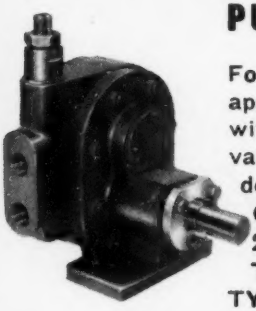

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TYPE A 320 g.p.h.
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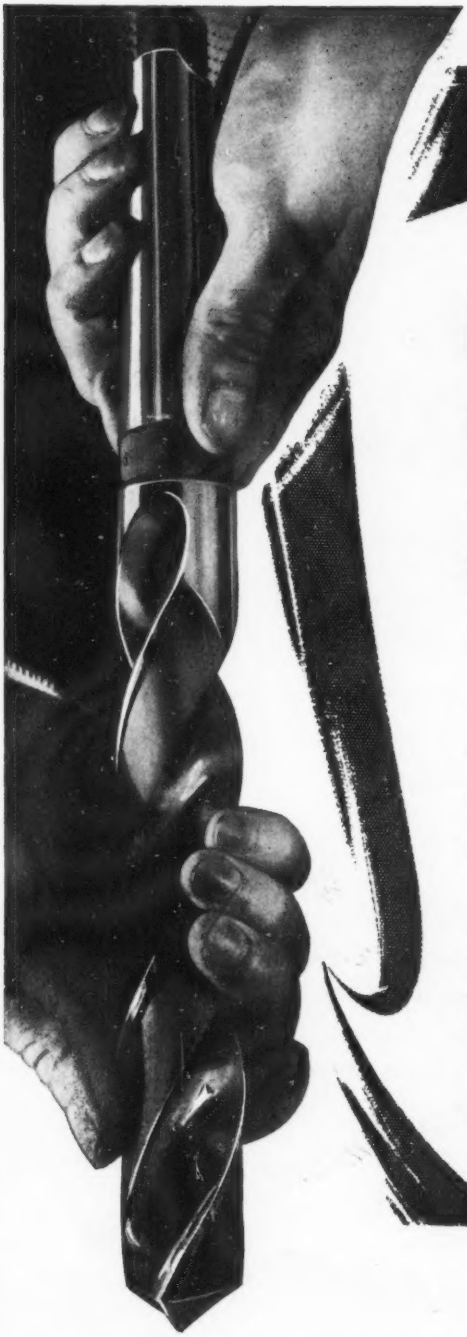

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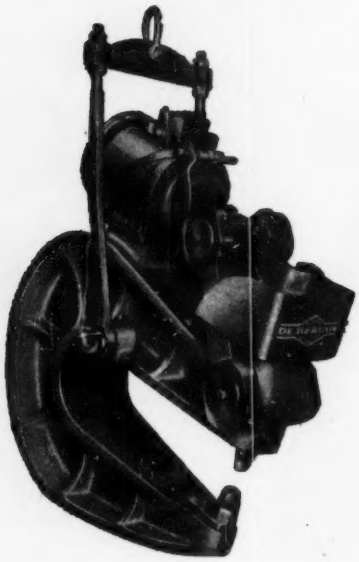

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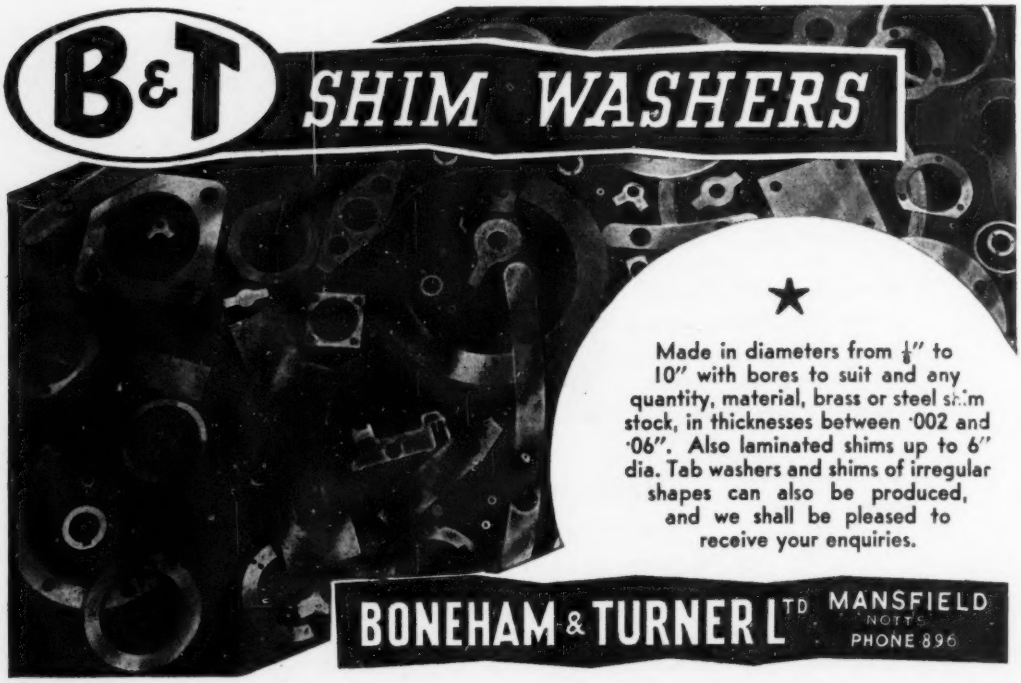

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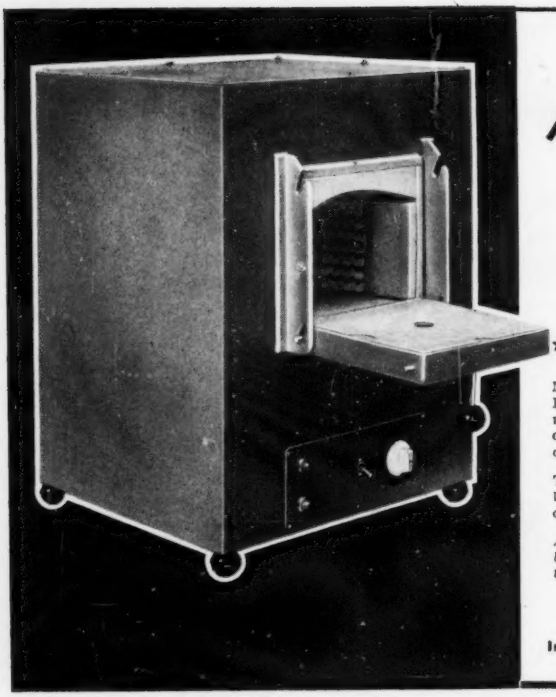

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an electric furnace of

ADVANCED DESIGN

for laboratory and workshop use

★ High Efficiency ★ Quicker Heating ★ Longer Life

New developments in the chamber insulation of A.E.W. Furnaces now enable the working temperature to be reached quicker and evenly maintained throughout the chamber. To further prevent heat losses the drop-down door is also efficiently heat sealed.

The elements are carried on interlocking refractory bars which allow free expansion and contraction without mechanical strain thus ensuring a longer life.

All A.E.W. Furnaces are designed and manufactured by specialists and you are invited to write for full technical details to

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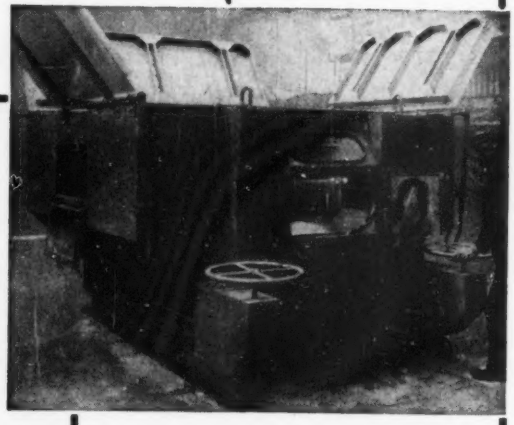
AEW

HYDRABRASION

we specialise in the manufacture of special purpose equipment



This illustration shows a special purpose Unit installed in a large Marine Gear Factory. Hydrabrasion not only cuts costs but obtains a finish which is impossible to obtain by any other method. A few of the unlimited uses of Hydrabrasion are fatigue improvement of springs and metal components, cleaning and preparation of drop forging and pressure die cast dies, etc. Deburring and smoothing of gears, internal cleaning and surfacing of tubular components, etc.

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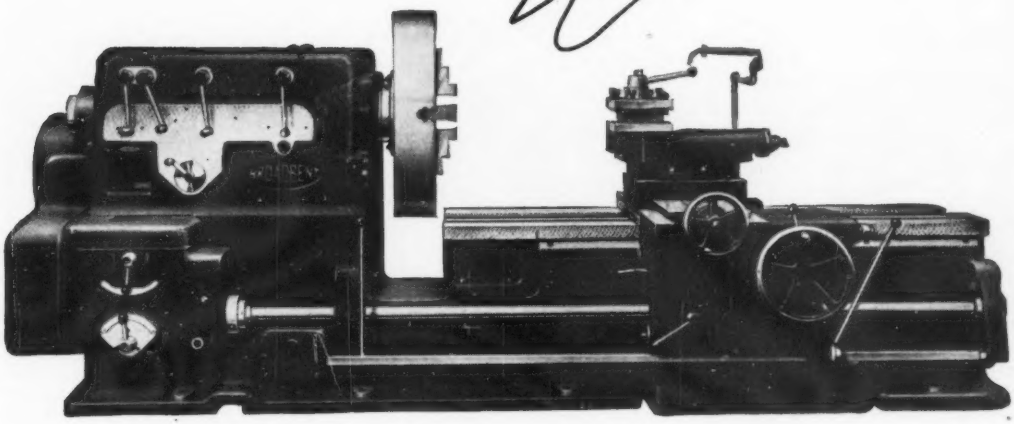
SURFACING AND BORING *Lathes*



17" to 36" SWING

The illustration shows a 32" to 36" swing machine ; other sizes are available from 17" to 28" swing.

This is only one of the fine range of robust heavy-duty Broadbent lathes, which have gained an unsurpassed reputation for reliability throughout the world.

Models can be supplied with any bed length required, with or without screw-cutting, hexagon, or square turret, and with special slides, to order.

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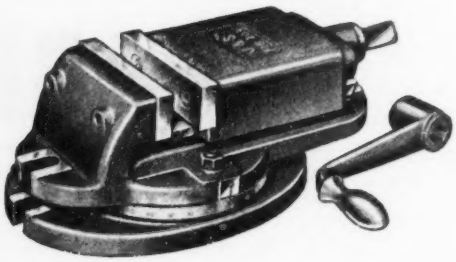
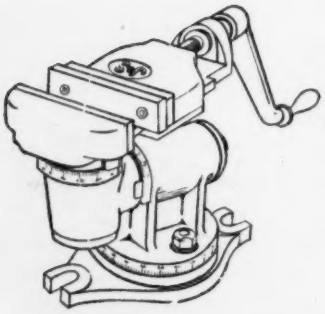
A **Kerry** Company

BAS/HB/2

machine vices

The range of J & S Machine Vices covers all kinds from precision types for light grinding operations to heavy duty models for use on Milling and Planing Machines.





Milling Machine Vices are manufactured in two types, plain and swivel, in a variety of capacities. An Angular Sine Vice is available for extreme precision work.

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J & S small tools

A. A. JONES & SHIPMAN LTD.,
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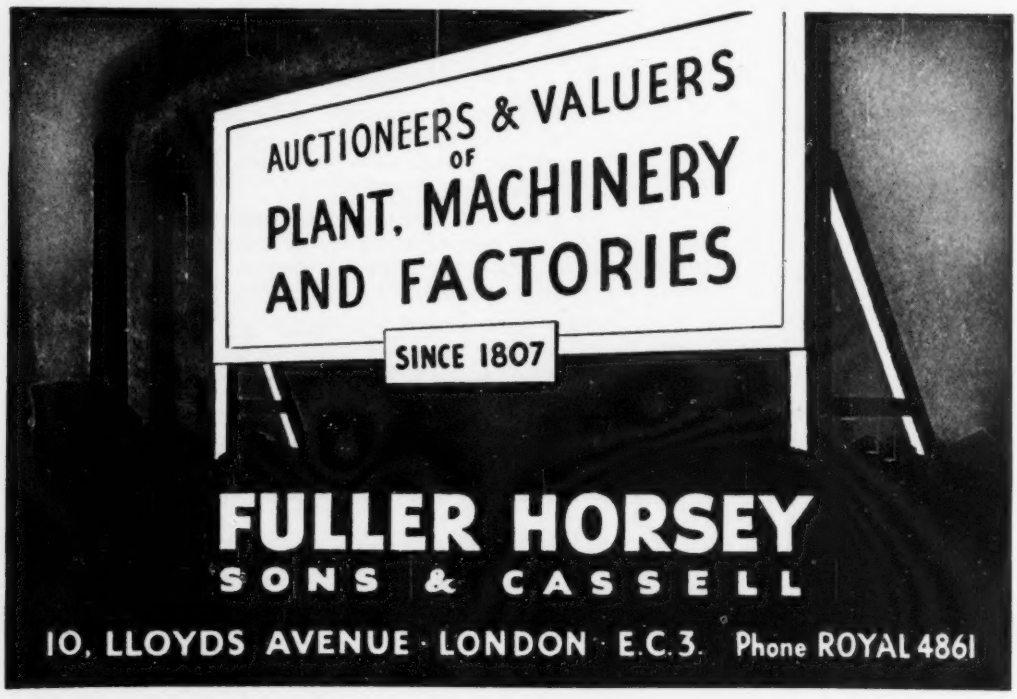
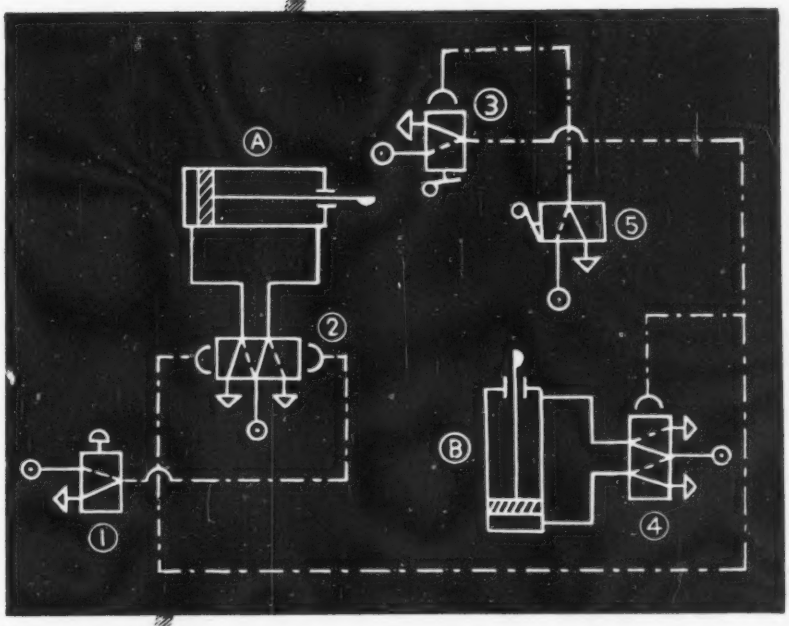
Telephone: Leicester 823222.
Telegrams: " CHUCK " Leicester.



MARTONAIR TECHNICAL ADVISORY SERVICE-6



The circuit shows sequentia operation of two cylinders. Although many types of sequence are possible by rearrangement of the components, the following cycle has been chosen for this illustration: A+, A—, B+, B—.

When the push-button of the 3-port valve (1) is depressed, mains air is connected to the pilot port of valve (2). As the other pilot port is exhausted through valve (3), the internal connections of the double pressure operated 5-port valve (2) are altered to those shown by dotted lines, and cylinder (A) outstrokes.

At the end of the stroke, the roller of 3-port valve (3) is depressed and mains air is applied to the left-hand port of valve (2) to reverse the valve to its original position and return cylinder (A). This signal is also applied to the pilot port of the single pressure operated spring return of 5-port valve (4) controlling cylinder (B), and cylinder (B) will start to outstroke. It should be noted that valve (3) has an "air reset" and will remain in the depressed position, keeping mains air on the pilot ports of valves (2) and (4), until a signal is applied to reset it. This signal is derived from valve (5), and is supplied when cylinder (B) completes its stroke. Valve (3) is then reset, exhausting the connections to valve (4) (and (2)) and allowing cylinder (B) to return.

The net effect is, then: (A) outstrokes, until (3) is tripped. (A) returns and (B) outstrokes, until (5) is tripped. (A) continues to return, if this is not already completed, and (B) returns. This cycle will take place every time that the push-button of (1) is depressed.

The Martonair Technical Service is freely at your disposal at all times. Fully qualified to advise on all aspects of applied pneumatics, the Service is backed by a staff of technical representatives throughout Great Britain, and by overseas offices and manufacturing companies.

Copies of this advertisement and earlier issues in this series are available from Martonair Limited.

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MANUFACTURERS OF PNEUMATIC HOISTS · CYLINDERS · CONTROL VALVES AND ACCESSORIES

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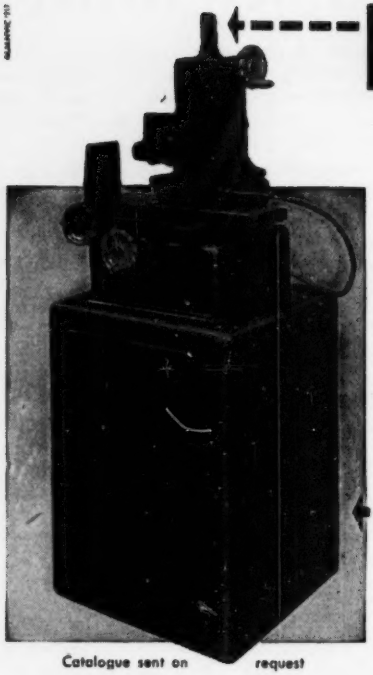

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Precision bench surface grinding machine

LIP

Developed for the watch clock instrument and allied industries

Capacity : LENGTH 202 mm
BREADTH 108 mm
HEIGHT 125 mm

Surface of magnetic chock :
105 x 152 mm.

Accessories available :

Stand
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Bolts, Screws, Rivets.

MULTI SPINDLE DRILLING AND TAPPING MACHINES
Adjustable arms or fixed centre heads.

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CRAFTSMAN BUILT MACHINE TOOLS

For continuous service over many years under exacting conditions, there is no better choice than Steinel machine tools.
Modern in design and exceptionally sturdy, it pays you to invest in Steinel.

Illustrated data available on each of the items shown

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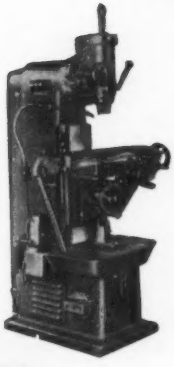
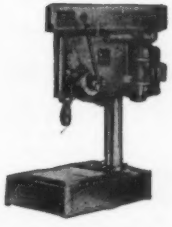
Hammering up to ⅝" rivet. Spinning up to ¼". Fine riveting up to ⅛".



VERTICAL MILLING MACHINES
with power feed. Table size: 8" × 29" also hand lever operated with table size 4½" × 9½".



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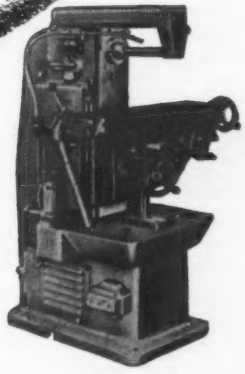
up to ½" capacity.



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Horizontal milling machines with power feed, table size 8" × 29". Also hand lever machines with table size 6½" × 27½", 4½" × 9½"

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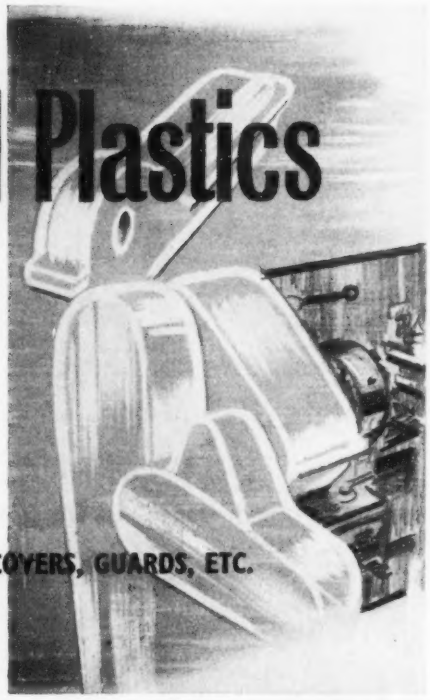

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Up to the minute in design and well ahead in performance, the GENELIN with its hydraulic drive means faster, smoother and more accurate bending on all work within its capacity. Ease of control and setting have received special attention and it should be noted that the drive, infinitely variable, from 0 to 100 ft. per min., is instantly reversible.

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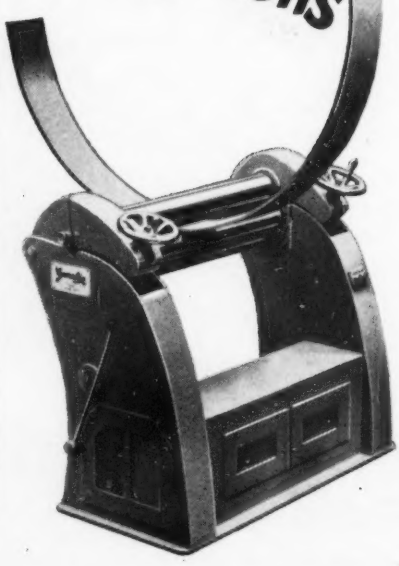

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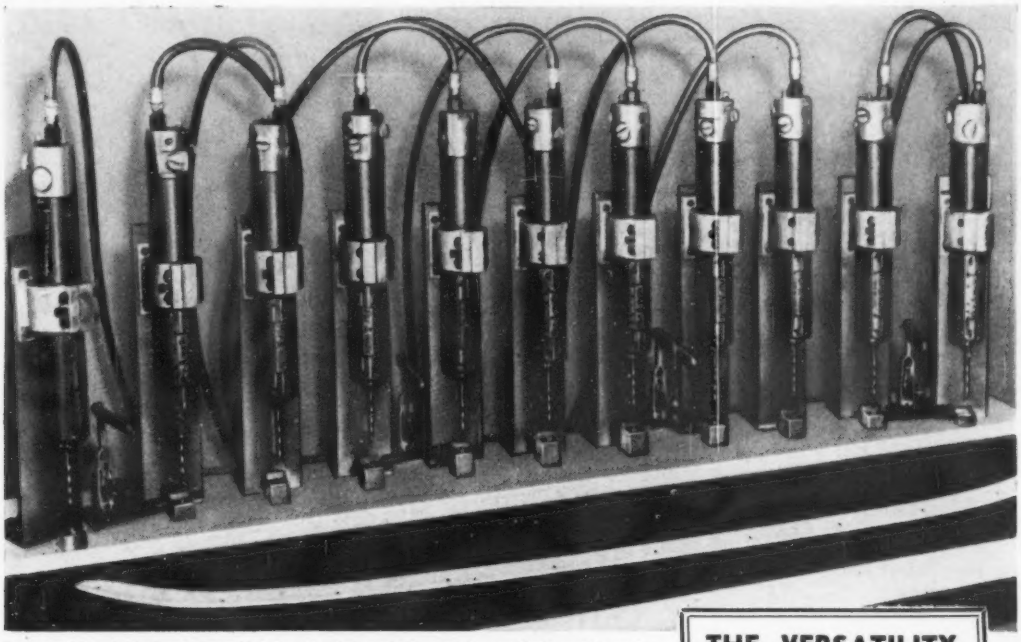

Battery of Par-A-Matics drilling 11 holes simultaneously in a motor car instrument panel.

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Save Man-Hours

Par-A-Matics are compact, self-feed pneumatic tools designed for multiple drilling, burring, tapping, grinding, reaming, nut-running, positioning . . . almost any operation requiring rotating tools which can be accommodated in a ¼" or ⅜" chuck.

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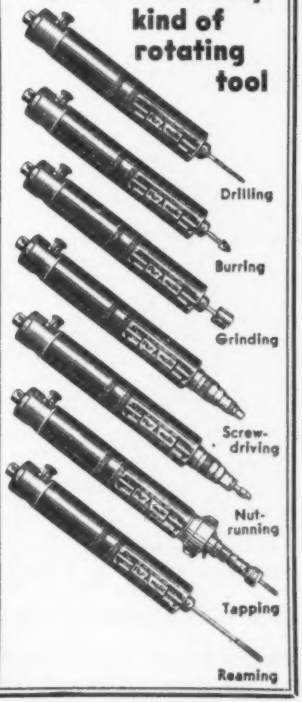
THE VERSATILITY OF PAR-A-MATICS covers almost any kind of rotating tool



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NUMBERING MACHINES

NUMBERING HEAD FOR METAL

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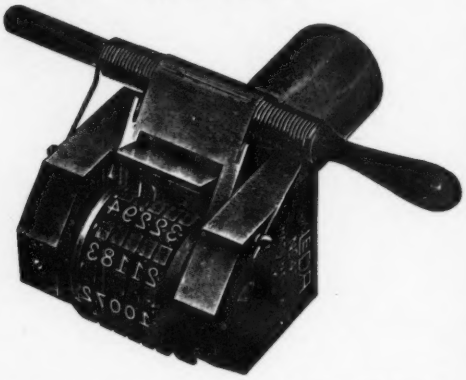
Power, Fly, Hand or Pneumatic Presses and similar equipment



It is used for marking Aircraft components with reference numbers, part and drawing numbers, date of manufacture, inspection mark, for marking Shells, Bombs, Cartridges, Engine Parts, Motor Car, Motor Cycle, Cycle, Wireless, Electrical, Clock, Watch and other instrument parts in all materials. Checks, Labels, Name Plates, Pigeon Rings, in fact any article which requires an identification mark. Mass produced articles can only be satisfactorily identified by individual reference numbers.

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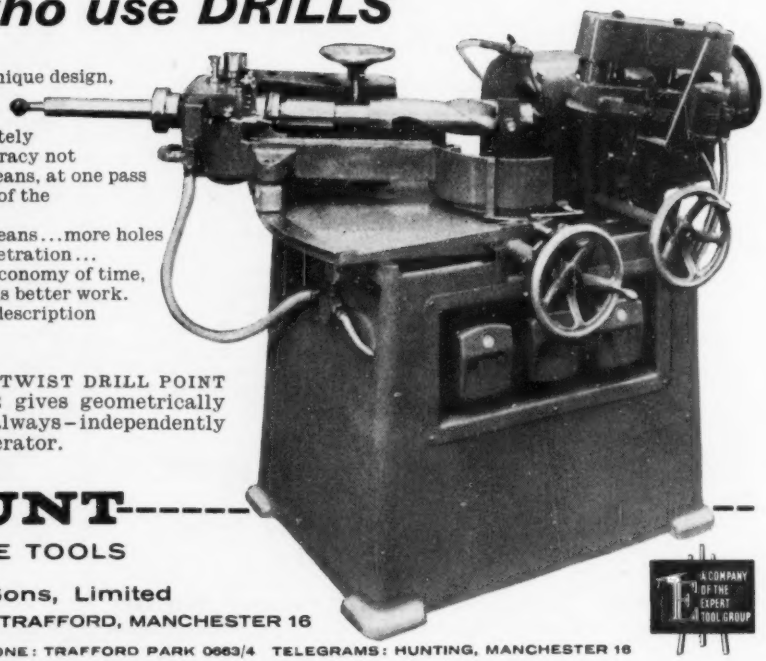
Accurate point grinding means...more holes ...truer holes...faster penetration... less power consumption—economy of time, effort and expense. It means better work. Please write for complete description and specification.



The new HUNT TWIST DRILL POINT GRINDING MACHINE gives geometrically accurate drill points always—independently of the skill of the operator.

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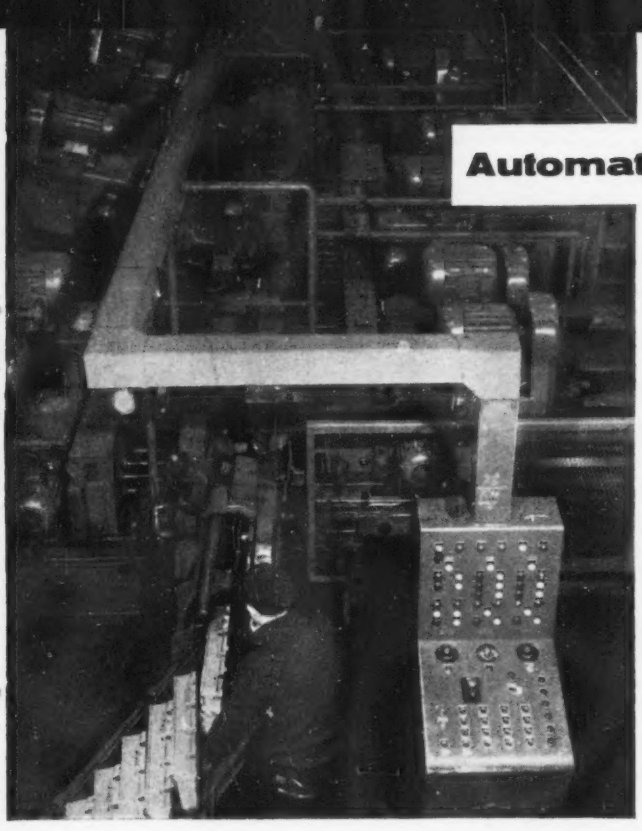

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is always a major asset
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but its efficiency
and rate of output are considerably increased
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That is why, in a highly competitive market,
Ford Motor Company Limited uses the
Asquith 47-Station Inline Transfer machine,
equipped with
VICKERS-DETROIT Oil Hydraulics
for drilling, boring, reaming and
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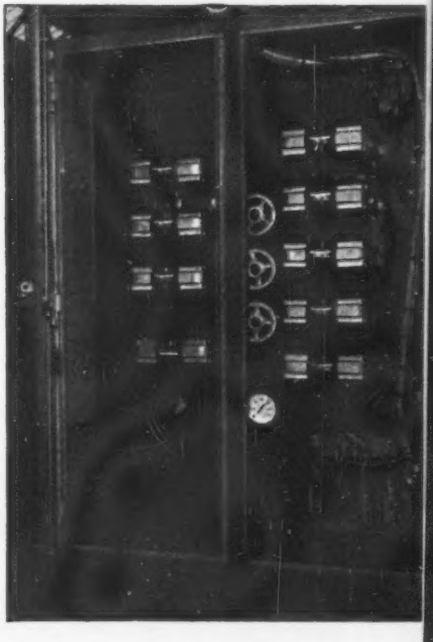
on 4 and 6 cylinder tractor heads.



View from the loading end of machine. Vickers-Detroit hydraulic units ensure perfect control of sequence operations, and uniform precision of components on leaving the machine.

View of a Vickers-Detroit control unit at the unload end.

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British Made
VICKERS-DETROIT
OIL HYDRAULICS

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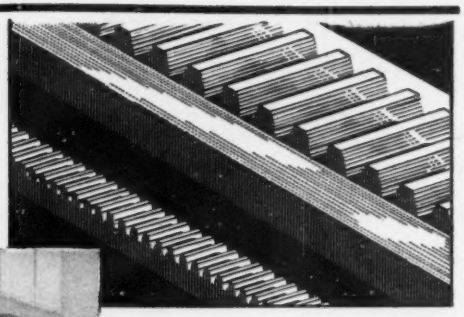

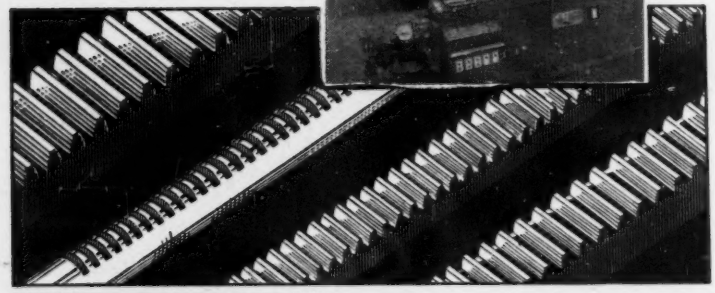

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The 'Bijur' system fitted to an Archdale Transfer machine at the Standard Motor Company's Banner Lane Factory.

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Tecalemit lubrication increases production time by doing away with oiling shut-downs, and by prolonging the life and precision of the machines. There's no oil wastage and maintenance costs are considerably cut.

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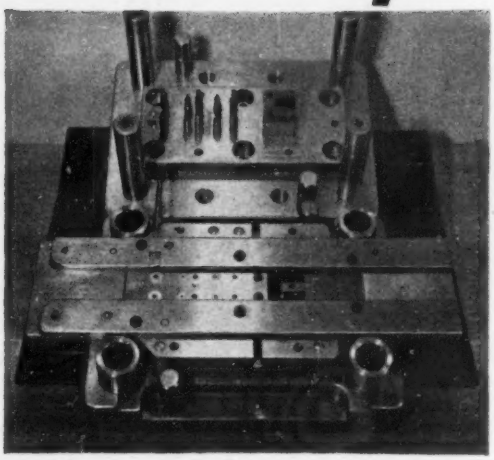

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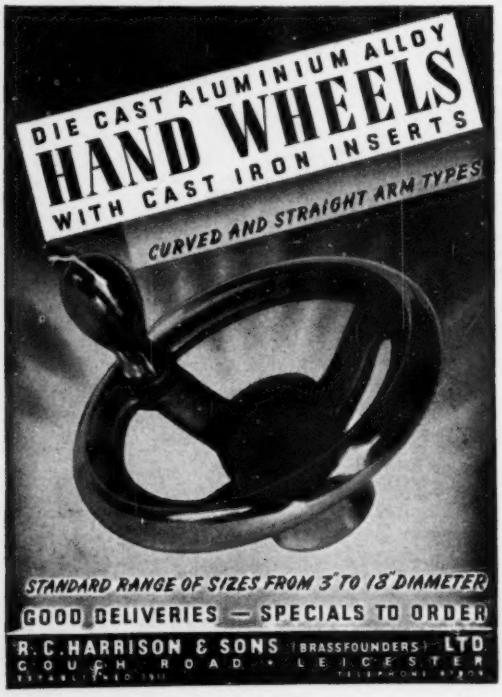
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HAND WHEELS
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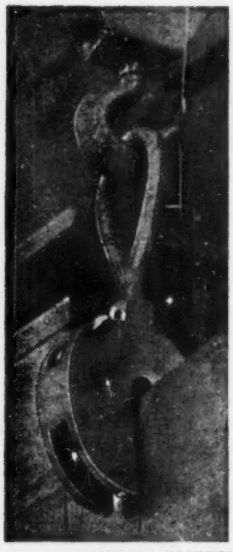

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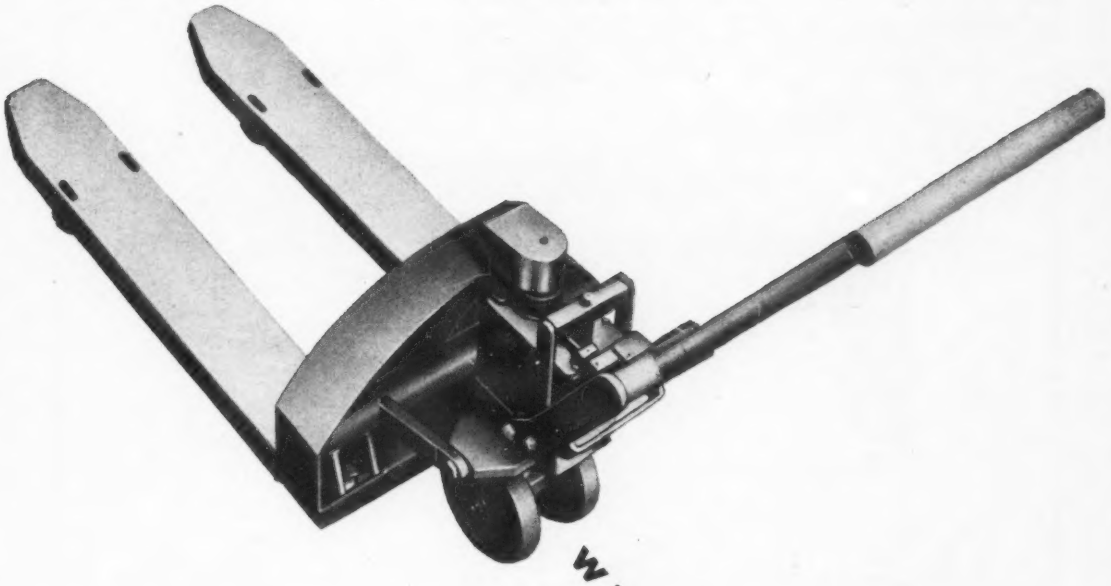

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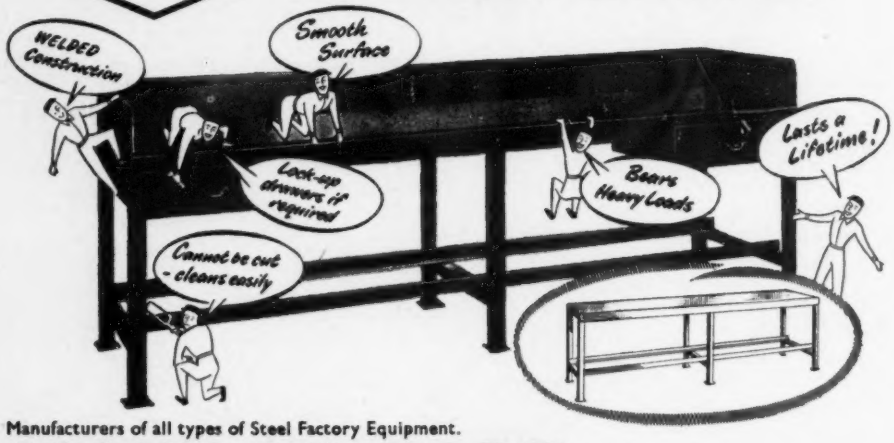

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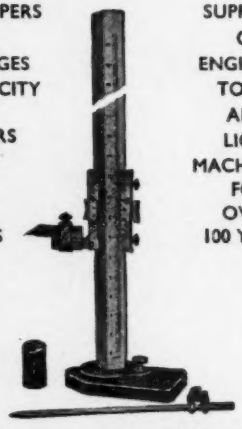

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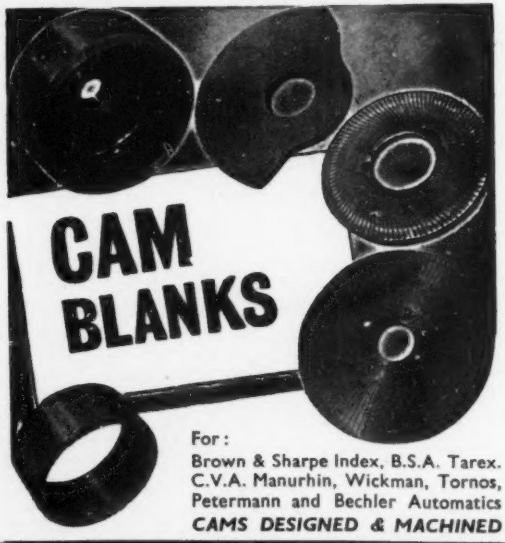

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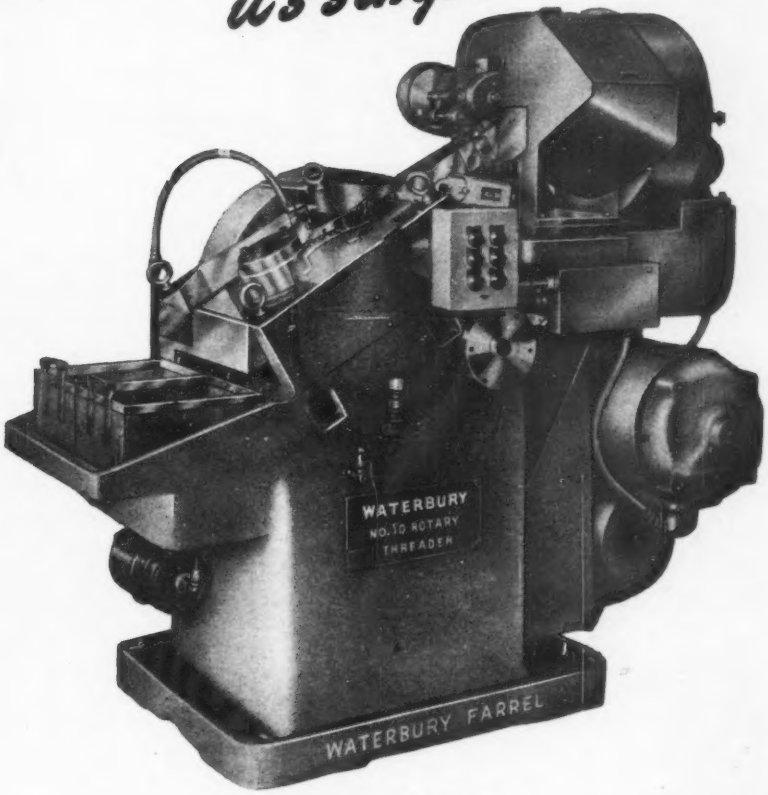

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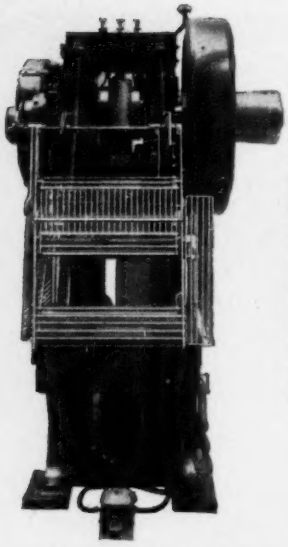

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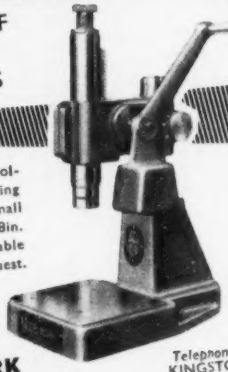

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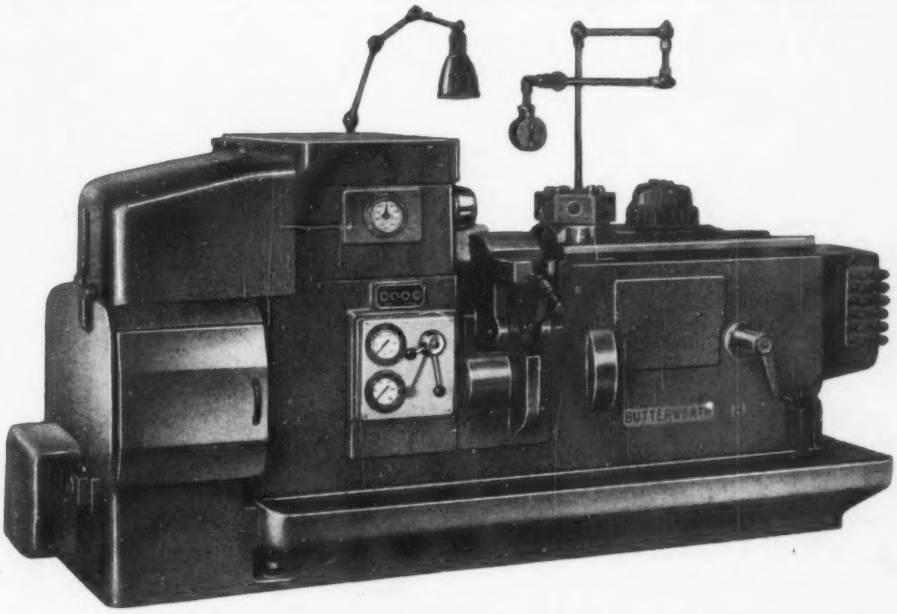

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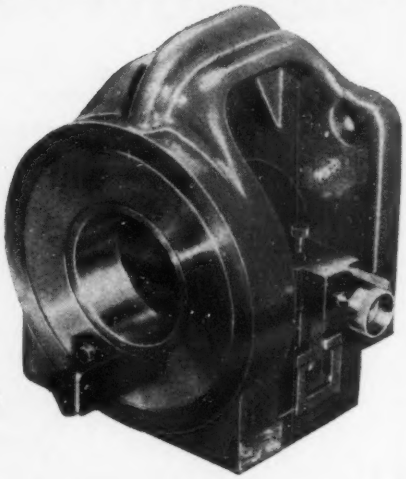

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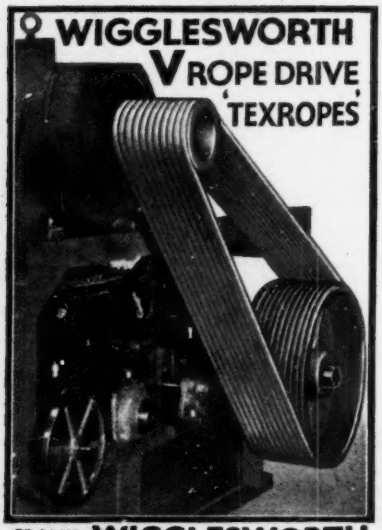

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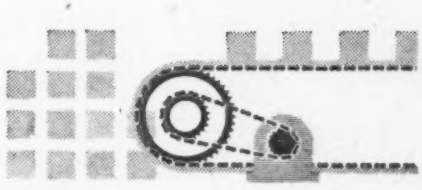

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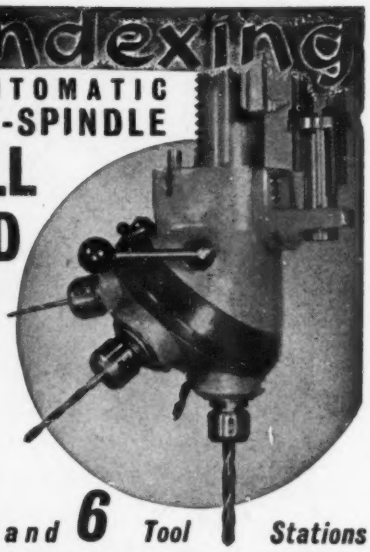

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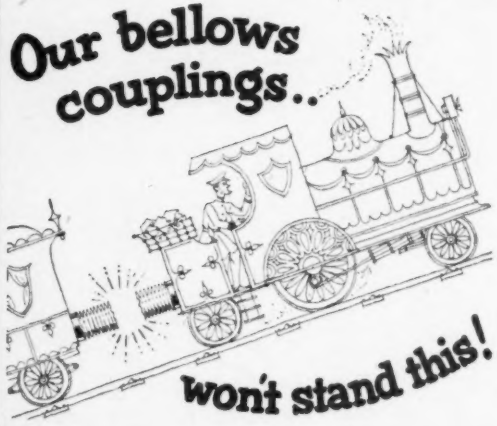

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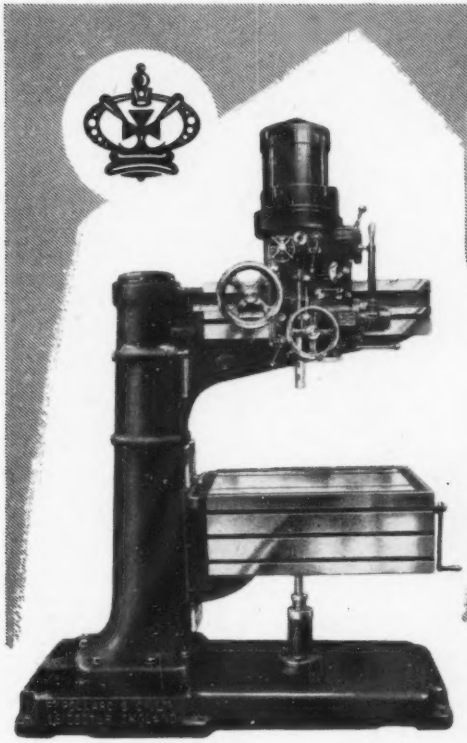

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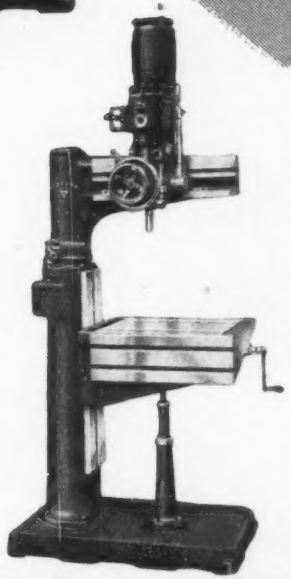

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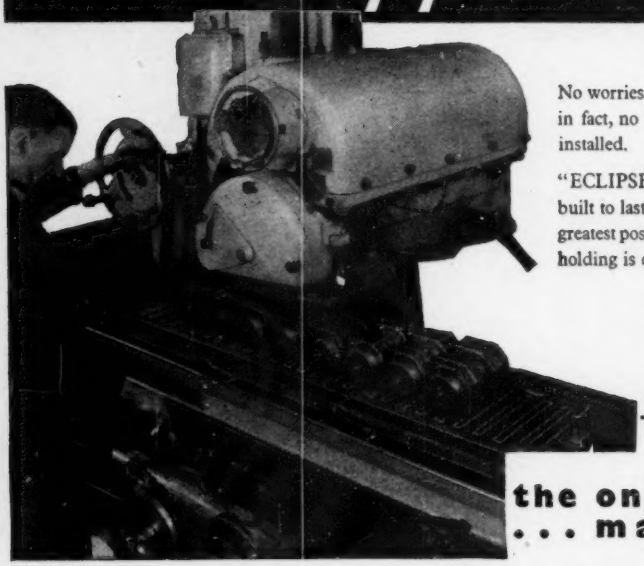

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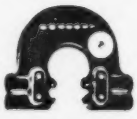

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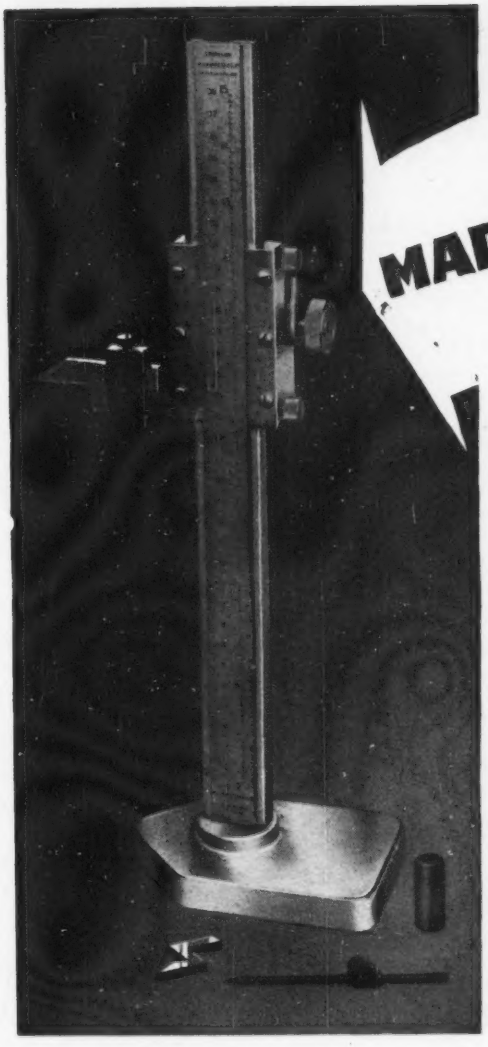

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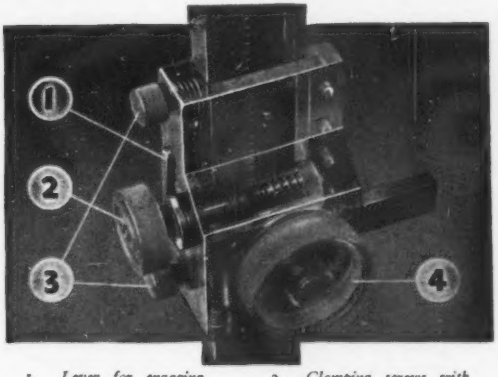

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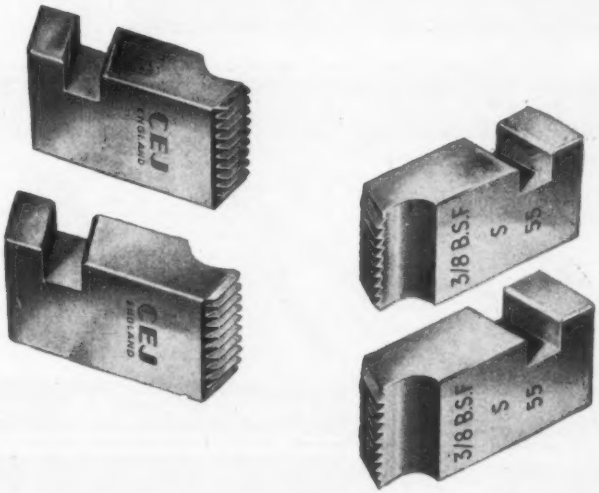

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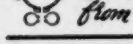

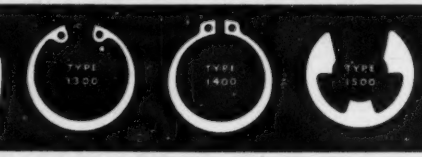

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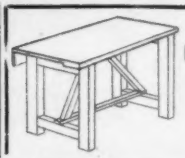

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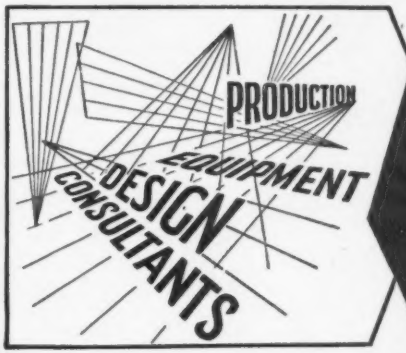

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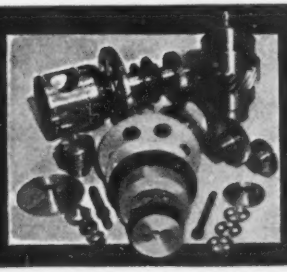

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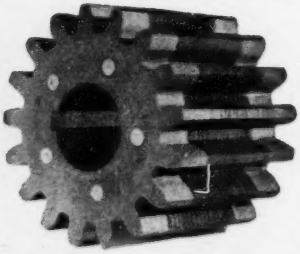

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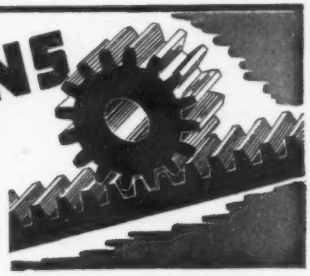

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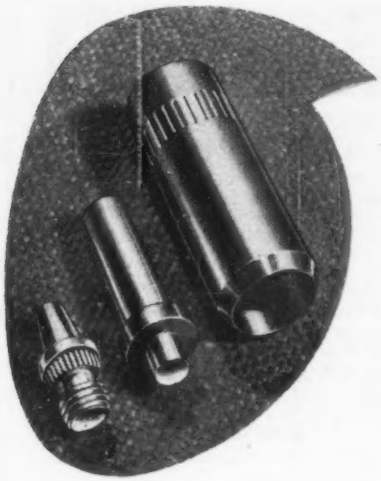

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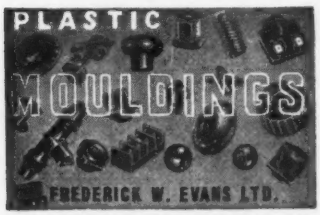

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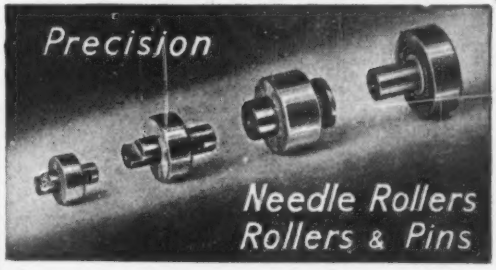

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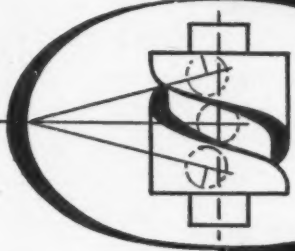

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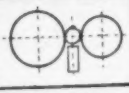

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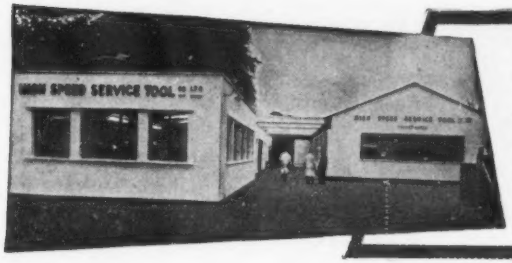

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PARKSON 2T Universal Milling Machine. Speed Range 15-360 r.p.m. Comprehensive equipment.
PARKSON 1NA Universal Milling Machine. Speed Range 17-450 r.p.m. Comprehensive equipment.
EDGWICK No. 2 Plain Milling Machine. Speed Range 21-380 r.p.m.
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FOSTER No. 2B Turret Lathe.

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HOLROYD T117 Thread Miller.
HELLER Automatic Thread Millers (4).

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LANG 8½in. S.S. & S.C. Lathe, to admit 4ft. 0in. between centres.
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F.L.C.B. 13in. S.S. & S.C. Heavy Duty Lathe, to admit 17ft. between centres, 2 saddles.

CAPSTAN LATHES

WARD No. 7 Covered Bed Capstan Lathe, with Tudor Concentric Chuck, 2½in. hollow spindle.
WARD 3A Capstan Lathe, with collet chuck and bar feed, 1½in. capacity.
WARD 2A Capstan Lathe, with collet chuck and bar feed, 1½in. capacity.

BORING MACHINE

TULLIS Horizontal Boring Machine, Floor Type with 3½in. traversing spindle, 9ft. 0in. by 2ft. 6in. tee-slotted baseplate.

DRILLING MACHINES

JONES & SHIPMAN Three Spindle Drilling Machine, No. 3 M.T., one spindle fitted with power down feed.
ASQUITH Type UGD Heavy Duty Column Drilling Machine, No. 5 M.T., compound table.
New **RICHMOND** 8R2 36in. Sensitive Radial Drilling Machine.

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CHURCHILL Model HCY Plain Internal Grinding Machine, swing 20in. over table, with hydraulic feed, as new condition.
NORTON 6in. by 30in. Hydraulic Plain Cylindrical Grinding Machine, maximum whee 20in. diameter.

MILLING MACHINES

ARCHDALE 28in. Horizontal Milling Machine; 49in. by 13in. table, rapid traverses in all directions.
HERBERT 23V Vertical Milling Machine, 68in. by 17in. table.
ARCHDALE 18in. Vertical Milling Machine, 38in. by 10in. table.
CRAVEN "Rigidmill" Production Milling Machines, working surface of table 39in. by 13in., spindle speeds 25-400 r.p.m. Two machines available.
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ARCHDALE 20in. Horizontal Plain Milling Machine, 30in. by 10in. Table.
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POWER PRESSES

HORDERN, MASON & EDWARDS L.20 and L.40 20 and 40 ton Inclinable Ungeared Power Presses.
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ROWLAND Model HDD Duplex Surface Grinder, max. between discs 7½in.
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MILWAUKEE 2K Horizontal Dial-type Miller, table 56in. × 12in.
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BORING MACHINES

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ASQUITH 7in. Horizontal Floor Boring Machine.
BERTHIEZ Model 9340 Vertical Boring Mill, table diameter 7ft. 10in., maximum turning capacity 9ft. 6in. (1953.)
JUNGENTHAL Model KE.1200 Vertical Boring Mill, table diameter 39in., maximum turning capacity 50in. (1954.)
NEWALL No. 1 Jig Boring Machine.
New **PFEIFER** Model F.60 Horizontal Universal Boring, Facing, Milling and Drilling Machine, 2⅜in. travelling spindle.
NILES Horizontal Boring Machine, 4¾in. travelling spindle, 60in. by 48in. table.
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RICHARDS Vertical Boring Mill, table diameter 36in.

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BRADFORD 8¼in. centre height by 30in. between centres Centre Lathe.
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GISHOLT Model 1L Universal Turret Lathe. (Two available.)
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DRILLING MACHINES

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LANDIS Hydraulic Universal Grinding Machine 14in. by 36in. between centres.
LANDIS Type D Hydraulic Crank Pin Grinding Machine, capacity 21in. by 72in.
LANDIS Type "C" Plain Hydraulic Cylindrical Grinding Machine, 10in. by 36in.
NORTON 10in. by 18in. Plain Cylindrical Grinding Machine.
ABWOOD Vertical Spindle Surface Grinding Machine, 6in. by 18in.
CHURCHILL Hydraulic Universal Grinding Machine, capacity 24in. by 72in.
New **TOS** Vertical Spindle Hydraulic Surface Grinding Machine, table 118in. by 24in.
New **TOS** Vertical Spindle Hydraulic Surface Grinding Machine, table 59in. by 12in.
New **TOS** Model BBZ.60 Centreless Grinding Machine, maximum capacity 2⅜in. diameter.
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MILLING MACHINES

MILWAUKEE No. 2H Vertical Milling Machine, table 50in. by 10in.
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MILWAUKEE No. 4H Plain Horizontal Milling Machine, table 74in. by 15½in.
VICTOMATIC Automatic Cycle Production Milling Machine, capacity 50in. by 10in.
REED PRENTICE No. 5 Vertical Milling Machine, table 68in. by 16in.
CINCINNATI Hydromatic 3/24 Duplex Production Milling Machine. (Two available.)
REED PRENTICE No. 6 Vertical Milling Machine, table 84in. by 20in.
CINCINNATI 1/12 Horizontal Production Milling Machine.
CENTEC Model 3R Automatic Production Milling Machine, table 6in. by 25in.
CINCINNATI 2M Universal Milling Machine.
REINECKER Vertical Milling Machine, table 51in. by 13¾in.
HERBERT No. 10 Vertical Milling Machine, table 31in. by 9½in.
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N2

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SMART & BROWN Model 'M' 4in. S.S. & S.C. Lathe.
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RUSHWORTH 8ft. × ¼in. Guillotine. Overcrank.
MODERN 2EE 18in. × 6in. Auto. Surface Grinder.
QUALTERS & SMITH 10in. Hacksaw.
COLCHESTER TRIUMPH 7¼in. × 48in. S.S. & S.C. Lathe.
MITCHELL 8¼in. × 4ft. 3in. S.S. & S.C. Lathe.
MIDGLEY & SUTCLIFFE O3SD Universal Miller. 38in. × 9in. Table.
MODERN No. 1. ¾in. capacity Capstan.
PROGRESS 5E Pillar Drill, 2in. capacity.
GRANOR 11in. × 5ft. HD Lathe, S.S. & S.C.
VELOX 7¼in. Hacksaw.
RAGLAN ¾in. Capstan. Bar Feed.
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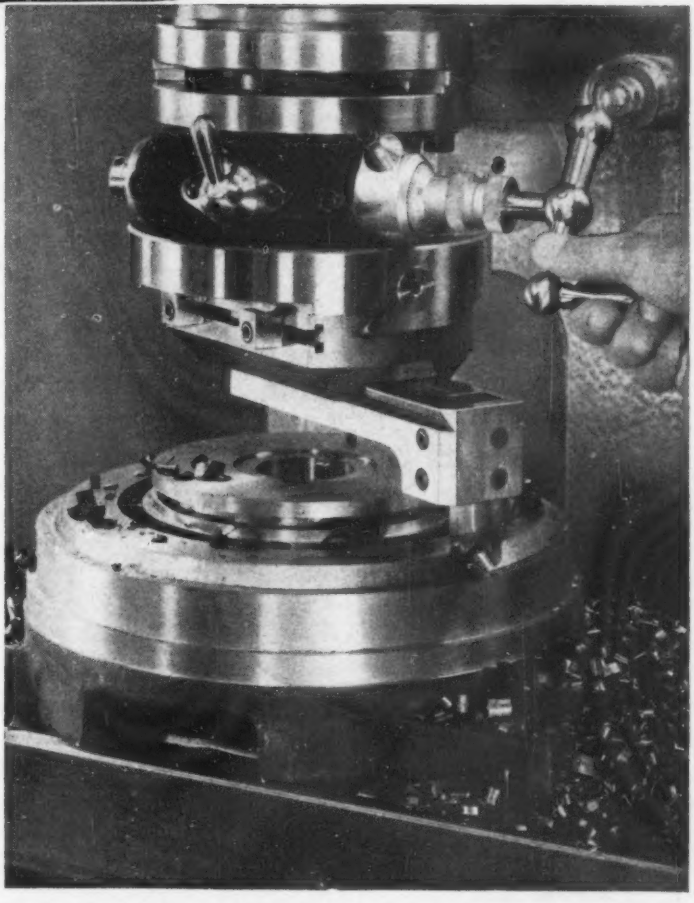

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CHURCHILL OSV 40in. × 10in. Vertical Spindle Surface Grinder, 1942.
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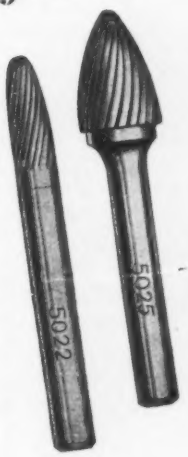

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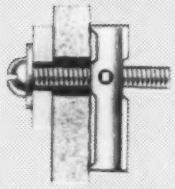
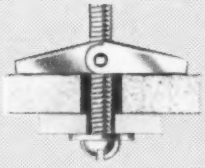


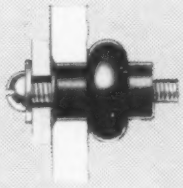
Gravity Toggles

A simple, ingenious and foolproof device for thin and hollow materials. A metal member is suspended off centre on the end of a screw. When inserted horizontally through the hole to the space behind, the long end falls into a vertical position by the pull of gravity. It is then drawn up against the reverse side of the material by turning the screw with a screwdriver.



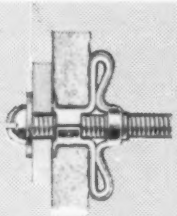
Spring Toggles

The wings of this device are spring actuated and automatically open out when pushed through the hole in any thin and hollow material. They are ideal for use in lath and plaster or plaster-board ceilings, and are very reliable because the wings spread the load over a wide area.



Rawlnuts

A soundproof, airtight and waterproof anti-vibration device for blind fixings to thin materials for which conventional fixings are unsuitable. A tapped metal insert is bonded in tough rubber. When screwed up a tight rivet head is formed at the back of the material.



Rawlanchors

This is an all-metal permanent fixing for thin and hollow materials. It is collapsed with a screwdriver (or a special collapsing tool for quantities). The anchor bends into a wing-shaped fitting on the reverse face of the material as shown in the illustration. Screws can be inserted and withdrawn at will.

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